THE
ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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TO "ELECTRICAL REVIEW" READERS.

Owing to the continued increase in the circulation of the ELECTRICAL REVIEW in recent months, an increase which has become accelerated since the signing of the Armistice, we cannot guarantee that casual copies will be available. The only way to make sure of securing a copy regularly as issued, is to place a definite order with a newsagent, or else to subscribe direct to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

ELECTRICITY SUPPLY PROGRESS.

THE war and its service have brought about vast changes in many departments of our scientific and industrial activities, as well as in our political and economic organisations; but there are few spheres, we should think, in which more remarkable progress has been made than in that of public electricity supply. During the war we have of necessity, for military reasons, had little to say upon this subject except in general terms; and, apart from claiming that electric power supply, by enabling our factories and workshops at short notice to turn over almost wholly to the manufacture of munitions of war, had played a leading part—indeed, an absolutely indispensable part—in winning the war, we have scrupulously avoided giving any clue to our enemies which might assist them in identifying the centres where their aircraft could wreak destruction most effectively.

This is the explanation of what must often have puzzled those of our readers who were in possession of certain information—facts which were, indeed, in some cases common knowledge—and found no mention of them in the columns of the ELECTRICAL REVIEW. It was not that we were not cognisant of them, but that it was not expedient to draw attention to them, even if the facts were widely known—for the REVIEW was studied also in unfriendly circles; and while a provincial newspaper might freely enlarge upon the electrical developments within its area, without undesirable consequences, in many cases *we could not do so.*

Now, however, while we must still exercise discretion in some respects, our hands are practically free, and our only serious limitation is due to the continued scarcity of paper, a trouble which is likely to abide with us for months to come, and which compels the exercise of brevity in all our undertakings.

But before we comment on the material progress in the development of electricity supply, we have a duty to perform—a debt to discharge on the spiritual side. Just as the hope of victory with arms resides in the moral of the fighting men, so the success of an industrial undertaking depends upon the human element from first to last. The elasticity of electric power, which is the pride of the electrical engineer, extends to only a limited degree in the case of generating plant and mains; and while imperative demands for power supply have poured into the offices, the staffs of the power stations have been engaged in striving to develop their resources correspondingly, under the greatest difficulties. Generating sets have been run for weeks—or months—on heavy and sustained overloads; boilers have been forced to their utmost capacity, uncleaned and without the periodical overhauling which is essential to their safe and economical working; mains have been hurriedly laid, sub-stations erected and equipped, and the work has been pushed on by night as well as by day, in spite of the lighting restrictions, which had to be suspended in view of the more pressing emergency of the demand for power. Moreover, breakdowns have occurred, as was inevitable under the stress of circumstances which involved

running without a pause on a continuous overload—in short, the engineers and running staffs, in every branch of the service associated with the supply of power to munition areas, have undergone an anxious and strenuous time practically without a respite during the past four years, and the greatest credit is due to them all, from highest to lowest, for the magnificent fight that they have put up on the home front, while many of them, of fighting age, were burning—and begging—to be released to share in the perils and privations of the trenches oversea. All honour to them—for they have "done their bit," and done it exceedingly well, although deprived of the honour and glory of the stricken field, and lacking the incentive of levying vengeance on the Huns in person.

An examination of the figures regarding electricity works extensions during the war, which we published in our issue of November 22nd, shows that between June 30th, 1914, and October 31st, 1918, the plant installed in 76 undertakings was increased, or in course of being increased, from 851,756 KW. to 1,821,281 KW.—*more than doubled.* The output of energy of those undertakings was increased from nearly 1,500 million units in 1914 to more than 2,500 million units in 1917—an increase of 70 per cent. in three years. Is not this a magnificent record?

We must not omit to award due credit to the manufacturing firms whose efforts have enabled this phenomenal increase to be effected; it must be borne in mind that they have also been busily engaged in fulfilling the requirements of the War Office and the Admiralty and the Ministry of Munitions at the same time as the power supply authorities, and that an enormous output of motors, switchgear, cables, and accessories has been produced during the war. Indeed, in every branch of electrical engineering, except perhaps those which might be described as purely luxury lines, there has been great activity, and as the electrical firms have been largely engaged in turning out their normal products, they are in an exceptionally favourable position to carry on after the war. We must also refer, in passing, to the important assistance rendered by the manufacturers, power stations, tramway authorities, and others to the Ministry of Munitions in the manufacture of shells, fuses, &c., and the heroic efforts of the tramway officials to maintain adequate services under extreme difficulties in the absence of renewals and repairs of track and rolling stock—but all these matters must be left for another occasion.

Elsewhere in this issue we are briefly reviewing the most important changes which have taken place in power station equipment. Most remarkable of these, we think, is the extraordinary upward leap of the Sheffield Corporation's undertaking, which, starting with 23,000 KW., has already reached 96,000 KW., and has obtained sanction for an additional 50,000 KW., making, when complete, a total of 146,000 KW. But that total will not be fully realised till 1920. Hardly less noteworthy is the rocket-like development of the closely adjoining undertaking of the Rotherham Corporation, which has advanced from 5,000 to 65,000 KW. In both cases the demand has arisen very largely from the triumphal march of the electric steel furnace, which was hardly known in Sheffield five years ago, but has now firmly established itself as an indispensable aid to the manufacture of high-grade steel on economical lines; moreover, the furnace has come to stay, and the demand for electrical energy, though temporarily dormant, will undoubtedly return directly normal conditions obtain. Other large increases of plant are recorded at Birmingham (51,650 KW.), Bradford (27,450 KW.), Glasgow (99,050 KW.), Leeds (33,660 KW.). Manchester (46,450 KW.), and Wolverhampton (16,450 KW.), amongst the municipalities; but some of these are only in the early stages of construction.

Turning to the company undertakings, whose plant has increased, on the whole, at a rather lower ratio, and their output at about the same ratio, the most striking development is shown on Tyneside, where the associated companies, starting with 86,000 KW., have added, or are adding, 114,000 KW., making a total of 200,000 KW. These companies, therefore, taken together, have by far the largest undertaking in the kingdom. Clyde Valley has increased from 35,000 to 72,500 KW., the Mersey Power Co. is going to install 24,500 KW. (part of a vast scheme), and the North Metropolitan Co. is putting down 21,068 KW. It is interesting to see how Luton, Redditch, and Stockport have jumped up from modest dimensions to stations of some importance.

One cannot help regretting that there was not in existence before the war a competent central authority, such as that recommended by the Board of Trade Committee, which would have been able to regulate the installation of new plant in accordance with the requirements of a well-considered national scheme. Since the report of that Committee was drawn up, the Ministry of Munitions has endeavoured to direct the flow of new plant into the most suitable positions, and, as we have noted from time to time, has discouraged the extension of installations unfavourably situated with regard to the probable requirements of such a scheme. But these efforts are more or less tentative; and as the scheme has not yet been formulated, it is impossible either to lay down authoritative lines upon which such extensions are to be carried out, or to proceed with new developments outside the scope of existing supply authorities. Hence the urgency of the need for definite action on the part of the Board of Trade, which we have already emphasised.

There is, however, one direction in which action could be taken without waiting for the national scheme to mature. It is perfectly certain that large units of generating plant will be required at an early date, and that if these are not put in hand without waiting for the national scheme, there will be serious delay before the latter can be carried into effect. In a letter to the *Times Engineering Supplement* of November, Mr. S. E. Fedden, of Sheffield, emphasises the importance of commencing the manufacture of the plant at once, and suggests that the Government should authorise the makers to put in hand some 25 complete sets of plant, each of 25,000 KW.; these would provide immediate employment for thousands of men and a large amount of machinery, and would be ready for installation when wanted, as they certainly will be, within the next three years. This is an admirable suggestion, and we trust that the Government will give it serious consideration; if adopted, it will go far towards cancelling the bad effects of the delay which has already been incurred, and there is not a particle of risk involved in the transaction.

Electricity Works Employes.

THE letter which we publish to-day from the Enginemen's Union (Marylebone Branch), regarding the award recently made by the Committee on Production in respect of London electricity undertakings, as the result of months of negotiation between the employers and employed, demands serious consideration. Assuming that the letter represents the views of the employés as a whole, it is a matter for sincere regret that the award, of which a great part was agreed at conferences between the parties, has not resulted in a fair measure of satisfaction. No such award, of course, could be expected to give complete satisfaction to either side, as agreement implies compromise; and a "compromise" which does not involve concessions on both sides is misnamed; but that an award which has been in operation barely a month should be thus emphatically denounced is most unfortunate. It will be seen that the workers are now asking for the total abolition of grading of men in all grades rated at 8½d. per hour, or less—that is, in nearly half the grades to which basic rates were allotted in the award. The list of complaints is a formidable one, but apparently relates entirely to alleged *breaches* of the grading system, and does not necessarily imply dissatisfaction with the grading itself. Apart, however, from those points, a demand is put forward for an all-round advance, which, if we understand it aright, amounts practically to 16s. a week, together with a reduction of the working hours from 54 or 56 to 47 hours a week, and the conversion of the war wages and bonuses into a permanent wage. On the face of it, this is a pretty tall order, and in view of the working conditions which are peculiar to the electricity supply industry, we do not see how it can possibly be acquiesced in by the supply authorities.

A CARRON CANTEEN EQUIPMENT.

It must be acknowledged that in pre-war days the interest of the average employer in the health and comfort of his staff seldom went very far. It occurred to few that it would pay to look after the well-being of workpeople during the hours of business; employés who are well fed, well clothed, and furnished with the conveniences and comforts that make for self-respect, turn out better work at a faster rate than others situated under less favourable conditions. Many employers have made this discovery only as a result of the changes brought about by the war. Better provision had to be made for personal comfort on the employment of female labour on a large scale, and it became necessary to arrange for feeding them on the spot. Experience shows that as its advantages are realised, and the workers discover that the canteen is run solely in their interests, they abandon their long-established habits and join in good, well-cooked meals taken under comfortable and hygienic conditions.

Fig. 1.—Exterior View of the Canteen.

We recently had the pleasure of inspecting the canteen which the District Iron and Steel Co., Ltd., Smethwick, Birmingham, an old-established firm in the district, has erected for the convenience and comfort of its employés.

Fig. 2.—Men's Dining Room.

Mr. H. C. James-Carrington, the consulting engineer under whose direction the canteen was built and equipped, and Carron Co., by whom the electrical cooking equipment was supplied, are to be congratulated on the excellence of the appointments of the canteen, which at present does not cater for more than 300 meals at a time, although designed to deal comfortably with 500. Two 12-hour shifts are worked in the steel-rolling mill, the employés being served with three meals during the day shift and three during the night shift. As we had an opportunity of judging for ourselves, we can safely say that the cooking is all that could be desired, and the prices charged are quite low.

The building is well designed both as regards convenience and appearance; the kitchen is situated centrally, and around it are grouped the four dining rooms—two for the use of the staff and one each for men and women employés. Fig. 1 is an exterior view of the building, while fig. 2 shows the men's dining room.

The electrical apparatus installed in the works' canteen was supplied and installed by Carron Co., and is a typical example of a number of similar installations by the same company. The central electric range (fig. 3) comprises two ovens, internally 22 in. wide, 20 in. high, and 22 in. deep, the loading being 5 kw. each, and two ovens, internally 43 in. wide, 25 in. high, and 19 in. deep, loading 8 kw. each. Over one of the 22-in. ovens is fitted a griller having a grilling space 22 in. wide, 15 in. deep, and loaded to 5 kw., and over the remainder of the ovens the company's standard boiler fillings are fitted, each filling being 22 in. × 28 in., and loaded to 6 kw. maximum per filling. A plate-rack is also fitted above the ovens, this rack being 8 ft. × 5 ft., and the controlling switchgear is mounted on this rack. Approximately the overall dimensions of this range are 7 ft. 9 in. long, 5 ft. 3 in. broad, and 3 ft. 6 in. to the top of the hob, the height from the hob to the underside of the plate-rack being 1 ft. 9 in.

Fig. 3.—Central Electric Range.

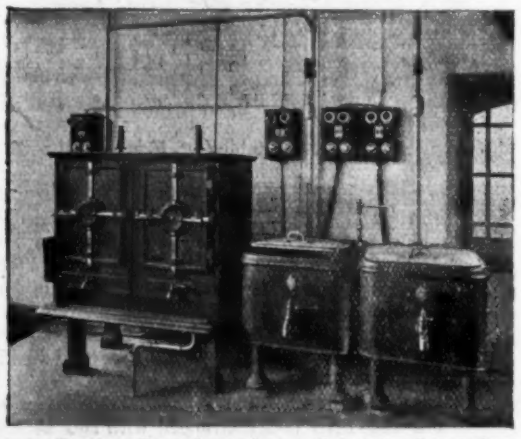

Fig. 4.—Boiling Pans (right) and Steaming Ovens (left).

The fish and stock-pot suite consists of two pans each, internally 18 in. × 14 in. × 6½ in. deep, loaded to 3 kw,

each, for fish, &c., and one larger pan, 18 in. × 14 in. × 11½ in. deep, loaded to 5 KW., for soup, stock, &c. This suite is mounted at one end of the central range, and has the control gear mounted at the front between the two front legs of the stand. The overall dimensions are 5 ft. 3 in. long, 2 ft. 3½ in. deep, height to hob being 3 ft. 5½ in.

The boiling pans (two of which are shown in fig. 4) are three in number, two being of 15 gallons capacity and one of 25 gallons capacity, each pan being fitted with vapour standard and back balance weight and chain to the lid. The construction in each case comprises a cast-iron inner pan with a sheet metal outer case, with the space between the two packed with slag wool, each pan being mounted on four substantial cast-iron legs.

The 25-gallon pan is internally 21 in. × 20 in. × 17½ in. deep, the height being 36 in. to the hob and the back standard 4 ft. high from the top of the hob. This pan is fitted with two inner wire baskets, one being 9½ in. deep and the other 7½ in. deep, and the maximum loading is 8 KW.

Each of the 15-gallon pans is internally 21 in. wide, 20 in. broad, 11½ in. deep, loaded to 6 KW. maximum per pan, one basket being fitted, 7¼ in. deep. The height to the top of the hob is 32 in., and the back standard is 4 ft. high from the hob.

The battery of two steaming ovens (fig. 4) consists of two ovens, each internally 16¾ in. wide, 22¼ in. deep, and 24 in. high, each compartment being fitted with five wire baskets and lid, the loading being 5 KW. maximum. The overall sizes of the body are 3 ft. 10½ in. wide, 2 ft. 1 in. deep, and

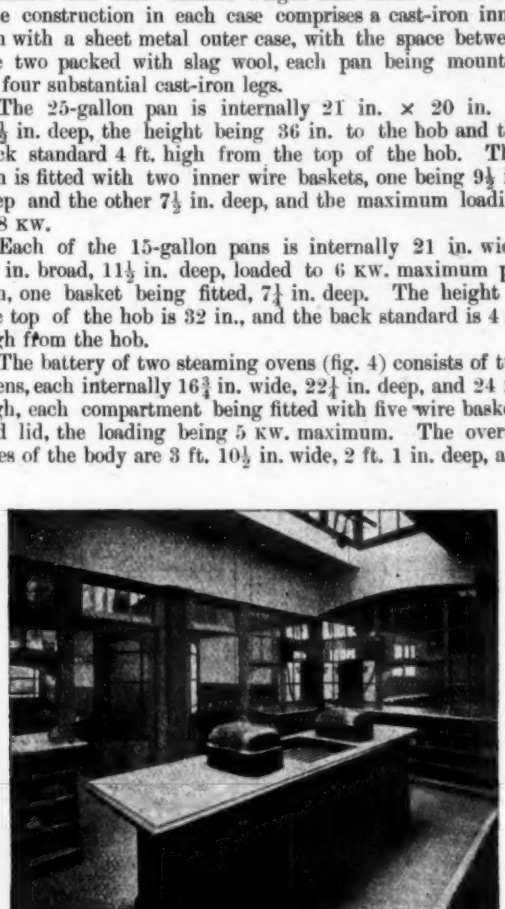

FIG. 5.—HOT CLOSET AND CARVING TABLE.

4 ft. 10 in. high. The cistern for maintaining a constant level of water projects 7½ in. from the body, and is 16 in. long.

The hot closet and carving table (fig. 5) is overall 8 ft. × 2 ft. 6 in. deep × 2 ft. 10 in. high, sliding doors being fitted on both sides, and the top being fitted with one open-type Bain Marie 27 in. × 24 in. × 4½ in. deep, loaded to 3 KW. maximum, and two carving wells each 18 in. × 12 in., loaded to 500 watts each maximum. The hot closet is loaded to 6 KW., and the control gear being mounted at each end.

In addition, there is a porridge boiler similar in construction to the boiling pans referred to above, and several tea, coffee, and hot-water urns.

The hot-water system is neat and efficient; in an outhouse is installed a coke-fired boiler arranged with two heating systems, one for town water and the other for rain water which is collected off the roofs of the buildings. From this central heater hot water is fed to the various points where it is required in the kitchen. The system is very economical, the consumption of coke being quite small, and the heater requires very little attention. The two water systems are entirely separate, although heated by the same fire, and provision is made to fill the rain-water tank with town water, should it be necessary.

Electricity is supplied by the Shropshire, Worcestershire, and Staffordshire Electric Power Co., being brought in at 5,000 volts and stepped down by means of a 300-K.V.A. Westinghouse three-phase transformer to 110 volts, at which pressure it is used for heating, cooking, and lighting, the high-tension switch cubicles, &c., being supplied by the Power Co.

The low-tension switchboard was constructed by the Mudie Electric Co., Ltd., Birmingham, to Mr. Carrington's designs, and the wiring was carried out by Messrs. Ellis and Ward to his specifications. The wiring throughout is in lead-sheathed cable, which provides a very satisfactory continuous earth by means of the lead sheath. The lighting is semi-direct, the arrangement being found a very satisfactory and economical method of lighting. The heating is by means of "Carron" electric radiators throughout; the design of heater is of a robust type, and quite satisfactory in operation. There are 24 of these radiators, each loaded to 3 KW.

The furniture of the canteen was supplied by the King Fisher Co., of West Bromwich, while the sinks were supplied by the Staines Kitchen Equipment Co., of London.

Above the canteen, on the second floor, is a well-appointed house occupied by the canteen manager, which house was also furnished by the District Co. The sitting room is furnished in Jacobean oak throughout, the bedrooms in English oak, and the kitchen furniture is of the Welsh pattern. The house is lighted and heated electrically; the kitchen, however, is provided with an ordinary kitchen range with back boiler, which works in conjunction with the main boiler tanks, enabling them to provide hot water for the bath-room, lavatories, &c., when the main boiler is not in use.

RECONSTRUCTION: LIMITATION OF PROFITS, EFFICIENT DISTRIBUTION, &c.

BY G. H. HOOLE.

THERE has been much voicing of general opinion on this subject, but very few definite proposals as to how best to take advantage of the peculiarly favourable conditions which obtain at the moment; conditions such as never obtained before, nor are likely to occur again in the lifetime of the present generation. There is undoubtedly a better feeling between master and man; between "Capital" and "Labour." There is a greater appreciation by politicians of the real power of the working classes. Those in authority have found, much to their surprise, that the people are prepared to back them up in any drastic proposal, irrespective of the inconvenience caused, so long as the proposal is for the good of the whole, and as the need after the war will be equally as pressing, they will agree to a much less degree of inconvenience.

The workers are expecting a definite lead being given, definite steps being taken, which will ensure to them a greater security against poverty, on the one hand, and tyranny on the other.

Unfortunately, it is rare that direction to any big movement beneficial to the masses comes from the masses, but the reason for this can be accounted for by the fact that they—with all respect—have not the ability to give that "direction." They state, it is true, in general terms what they want, but it is purely generalisation; they cannot, unfortunately, furnish a plan of the route to be followed to attain their ends.

Certainly they have advanced, but the power to direct effectively takes years "to acquire"—and they were bad starters. And when, as the result of repetition of their wants, a solution is not forthcoming, they consider that they have been badly treated, and, as a result, frequently resort to force—to them the only alternative—but this procedure is changing. The responsibility, to a very large extent, rests on those who have the ability, and are in authority, to render the lives of the people more tolerable.

The proposals I would put forward as a basis for reconstruction come under the following headings:—

1. Relationship between Capital and Labour.
2. Relationship between the State and Capital and the State and Labour.
3. Distribution of commodities.

Relationship between Master and Man, or Capital and Labour.—The Whitley Committee put forward certain proposals which, if acted upon, will certainly lead to a better understanding, and consequent smoother working; but the proposals are not bold enough.

Surely the Committee has misjudged the pulse of the people. It regards it as being weak instead of at full strength, the life blood pulsating through the body in a manner indicative of sound robust health. Has not the Committee been afraid that "Capital" could not stand too much of a shock and that "Labour," was not in a fit state to take strong nourishment? That is wrong. Capital is sane, strong, and vigorous; Labour in the same healthy condition, and they face each other, instead of being side by side. Each is prepared to do the right thing so long as it can be convinced that the right thing is that which is for the good of the people as a whole.

There are no real leaders of Capital who desire the slavery of their fellow men; nor are there any true leaders of Labour who desire to make bankrupt the capitalists. The position stated truly, and without heat, is: the capitalist does not wish to hoard, but naturally—I use the word in its human sense—wants a reasonable return for his capital outlay; whilst similarly the Labour man wants a greater return for his capital—*i.e.*, his labour.

The Whitley proposals of Councils, &c., should be the first stage, and as the outcome there should be:—

1. Better working conditions;
2. Greater output;
3. Shorter hours—

benefiting both parties and the nation as a whole. The masters would save in obvious ways—such as lighting, heating, power, waste of man-hours, &c.; whilst the man would benefit by having more recreation and better health; and it cannot but be agreed that the two sides of the account balance.

Having got over the first step, the next is that of limitation of profits, and this is a subject bristling with difficulties; but does not that fact make the subject more worthy of solution? Parliament should pass an Act limiting profits to, say, 7½ per cent. after making provision for the following:—

(1) Depreciations: the per cent. to be definitely laid down by a Committee for buildings for the different industries, different classes of machinery, &c.—*i.e.*, allow fair and reasonable depreciation allowances. Then (2) a sum of money should each year be placed to an "Industry Reserve Fund" to ensure that during lean years the capitalist gets his 7½ per cent. return and the workman his wages; (3) workmen's holiday pay; (4) workmen's sick pay; and (5) workmen's pension fund.

If, after these charges have been met, there is a profit of over 7½ per cent., that surplus should be expended in cheapening the article produced, to the consumer—*i.e.*, the general public should reap the benefit. The cost of goods would not reach anywhere near the figure we are now paying for them and, I believe, would not be much in excess of pre-war conditions—first, because of the greater output, and, second, because of the redistribution of the profits.

These proposals in no way cut out competition, but rather encourage it, inasmuch as the most progressive, up-to-date firms would yield the greater dividends, enabling them to offer the cheapest goods. The effect would be to shut down the smaller unprogressive firms—those where workshops are dens and where working conditions generally are bad. The firms who treat the industry on scientific lines, whose members—principals and staff—have one object in view: the maximum output at minimum cost, consistent with the proposals made, are the firms who have the right to the front place in industry.

Greater output is certain to result, all workers in the firm having a real interest in the success of the firm. The making of goods in the firm's time and of the firm's material will be reduced to a minimum, each workman recognising his loyalty to his fellows and to the firm. This is only one of the minor savings, but it is mentioned as an illustration. This factor of greater output is one of the most important, and one which, to a great extent, rests with the worker, but he, of course, must have every mechanical and technical facility to that end.

How would these proposals affect our foreign trade? I venture to say very slightly, if at all, as the balance-sheet of the cost of the article may roughly be said to be as follows:—

Debit.	*Credit.*
Extra cost of improved conditions.	Increased production.
Extra cost:—	Increased saving of power and lighting.
Wages.	Saving of costs of strikes and disputes.
Holiday pay.	Reduction in dividend.
Sick pay.	
Pension fund.	

And the conditions obtaining in other countries should be borne in mind. Naturally, the old age pension would fall out automatically in a few years.

Distribution.—In this connection the most drastic methods should be employed, as the national waste in duplicate distribution is appalling and unworthy of a great nation. The case should be dealt with thoroughly from the railway down to the baker's cart.

Railways.—I am against nationalisation, as it is too clumsy and too expensive; but Parliament should pass an Act compelling railway companies to work definite areas for goods traffic. At the most there should not be more than one company for Scotland, one company for the North of England, one company for the Midlands, and one company for the South of England, with special arrangements for the long-distance lines.

The companies should be compelled to amalgamate to this end, *i.e.*, the saving of time, men and material. A big financial saving would result.

Provisioning of Areas.—As regards town and country distribution: in this connection, centres of distribution, *i.e.*, shops will be dealt with as well as the actual distribution.

England wants every available man now, so as to increase her wealth; every penny which is at present wasted should be saved. Dealing with a large town first: the organisation would be to divide the town into areas, say, of 10,000 people, and in each area arrangements should be made to ensure that there be no more than an *adequate* number of shops to meet the requirements of that area, *i.e.*, all food requirements, coal, and minor requirements such as boot repairs, &c. Is there any sense in five grocers' carts coming into one terrace to supply five different people? The shopping centre of the town would consist, then, of such shops as:—Jewellers, drapers, milliners, clothiers, haberdashery, fancy goods, &c., and other articles not of daily requirement. The saving in men, horses, time, and property would be enormous, especially when it is remembered that the distribution from the wholesalers would also be reduced. The area shops should be controlled by companies, if possible, made up of the present shopkeepers of the area—but if they cannot agree to form a company, then outsiders may step in.

Apart from the saving referred to, it would be a national asset to close many of the small shops, as they have a daily struggle to "make ends meet." Would the people agree to it? Have they agreed to rationing?—and the need is equally as urgent. It would not be nursing the people, but educating them. Care should, of course, be exercised that each area is amply supplied and the prices throughout the country systematised, which is a simple matter. Tea, flour, cocoa, coffee, milk, &c., at standard prices, but no rationing. In the country the same wastage occurs, and the same remedy should be applied. At present there are butchers' carts travelling miles to a village where there is already a shop; similarly half-a-dozen grocers' carts will come to a village which has a store and a railway station. There is also an important change to suggest—and that is, "No credit." During the last four years, many outstanding accounts have been cleared up owing to the high wages, and the time is opportune for the cancellation of the credit system in foodstuffs—a pernicious system.

Relationship Between State and Capital, and State and Labour.—It will be observed that provision has been made for the State to lay down what profits a firm should make and for a rational distribution scheme to be brought into force, and there only remains the question of the interworking between industries to prevent overlapping. For instance, one industry specialises, whilst there are many

that may be termed bastard industries—*i.e.*, industries which touch the fringe of others, and produce a cheap and inferior article, to the detriment of the industry proper. Those places which are not proper to any particular industry should be closed, otherwise the nation is losing man-power, &c., and the State should step in and stop it. I do not, of course, refer to repair shops, but to "producers." The State should also receive from every firm the excess profits where the profit is over 7½ per cent. after the conditions previously mentioned have been met and the article has been reasonably cheapened, so as to form a fund for the opening up of new industries or for the assistance of decaying industries.

THE USE OF HIGH-PRESSURE AND HIGH-TEMPERATURE STEAM IN LARGE POWER STATIONS.

On Wednesday, November 27th, Mr. J. H. Shaw, A.M.I.E.E., read his paper (an abstract of which appeared in our issue of July 19th, 1918) at Birmingham before the South-Midland Centre of the I.E.E.

Mr. L. S. Carr, discussing the paper, said the question could not be considered from the point of view of thermal efficiency only, for it did not follow that the most highly efficient conditions would naturally be the best from a commercial point of view. With turbines a very high vacuum was required to obtain high efficiency, but this vacuum called for heavy capital expenditure for condensing plant, and, in inland stations, heavy costs for cooling towers and pumping, and in the same way they had to consider what very high pressures and temperature would entail in the way of capital costs and maintenance. At present there were very few data available regarding those—at any rate as to extra-high-pressure. They had had three years' experience with steam at a temperature in the neighbourhood of 700 deg. F., and had experienced no trouble whatever as regards the erosion effect on blading. Gunmetal fittings had to be replaced by steel or one of its alloys, but otherwise the results had been most satisfactory. Glasgow's new station was designed for 250 lb. per sq. in. and 250 deg. superheat, and boiler plant at a new station on the N.E. coast for a working pressure of 475 lb. per sq. in. and 700 deg. F. was now being installed, which was a big advance on anything attempted in this country before. He hoped the figures of capital, running and maintenance costs, and steam consumption would be published. He would like to see the term "pounds of coal per kw. generated" abolished; it was entirely misleading. When making a comparison between two districts it was obviously unfair to attempt to compare on such a basis a station using coal of 12 or 13,000 B.Th.U. with one using that of, say, 8,000 or 9,000. The latter, though it might be burning more lb. per kw., might be the more highly efficient. He thought that for machines of 15,000-kw. rating and upwards it would be found that the very high vacuum figure of 29.1 given by the author would be taken full advantage of, owing to the huge volume of steam to be dealt with, entailing unmechanically long blades at the low-pressure end; 28.8 was nearer the mark. An article appeared in the March number of the *General Electric Review* by Eskil Berg, of the turbine engineering department of the General Electric Co., of Schenectady, which he would advise anyone interested in the subject to read.* In it the benefits derived from high pressure and high superheat were very clearly shown by means of tables and diagrams.

Mr. H. Bentham asked the author if he had any actual operating figures, no matter how small, to compare with the tables. In Schedule V, columns 3 and 11, a saving of 8 per cent. in fuel consumption was shown by raising the steam-gauge pressure from 200 lb. with 200 deg. F. superheat, to 300 lb. with 300 deg. F. superheat. The hesitation of most engineers to adopt very high pressures and temperatures was on account of the added possibility of breakdown, which would not only wipe out possible economies, but might dislocate the running of the station. The higher temperatures would lead to serious expansion troubles, particularly in turbines of the reaction type which depended on fine clearances for their efficiency. Could the author say whether high pressure or temperature had anything to do with the recent breakdown of the two 35,000-kw. and one 25,000-kw. turbines in the States?† He had inspected the high-pressure and superheat B.T.H. and Babcock combination at Rugby after a long run, and apart from the scoring of the first row of nozzles, which received the high-pressure steam and, he believed, the first row of buckets, it was in excellent condition. That set, however, was small, and he was afraid expansion trouble would occur on sets of 5,000-kw. to 10,000-kw. capacity. He could hardly agree that the total works costs were not likely to be affected by the use of higher pressures and temperatures. There was no doubt that maintenance costs would wipe out fuel saving if one ventured to operate some existing plant at higher total temperatures than 600 deg. F. Additional expansion due to higher temperatures would undoubtedly set up further "racking" strains on the pipework. At one large power station they were discarding all welded steam piping on their main steam ranges, and substituting riveted pipes and flanges owing to serious troubles with the welded type at high temperatures.

Mr. R. A. Chattock criticised some of the figures given; such a valuable paper ought to represent accurately what was being attained in modern power stations rather than include figures, which the author himself described as being optimistic. The statement that cooling towers could not be expected to obtain a lower bottom temperature than 75 deg. F. was hardly correct. In Birmingham they were obtaining an average temperature throughout the year of 71 deg. F., and the vacuum corresponding to that was 28.3 in. Coal would not come down as low as 10s. per ton for a good many years; the average price when things became normal would be about 15s. per ton, and he thought the figures should have been worked out on that basis. He considered that a vacuum of 29 in. should be easily obtained with a circulating-water temperature of 60 deg. F. As an average figure, an overall efficiency of boiler-house plant of 77.5 per cent. was practically unobtainable. Whilst it was true that on individual boiler tests, including economisers, efficiencies of 80 per cent. to 85 per cent. could be obtained, the average efficiency of the whole of the boiler-house over a period of twelve months could not be expected to be higher than 70 per cent., and it was generally even lower than that. The coal per unit was stated in lb. throughout the paper; it was more useful to state it in B.Th.U. per unit. For comparison lb. of coal per unit was quite misleading. He was very glad that the author had referred to the importance of de-aerating the condensate and make-up feed water. With the very pure water that it was necessary to use in modern high-duty boilers, the liability to internal corrosion of pipes and economisers was very great, and it was of the utmost importance that the carbon dioxide or the oxygen contained in the water should be removed. The closed circuit system of handling the water should be adopted, and the temperature should be raised to at least 180 to 200 deg. F. Most firms building condensing apparatus were now looking into that question. The advisability of using high pressures and high temperatures was quite recognised amongst engineers. In Birmingham they were proposing to press the boilers up to 325 lb. per sq. in., and to superheat up to a total temperature of 700 deg. F.

Mr. J. G. Mackersie said it would be interesting to know how the author arrived at the figure of 8 per cent.; 1.538 lb. of coal per hour was an estimated figure for the standing losses of the power station under discussion with a working pressure of 200 lb. per sq. in. It was proposed to add 8 per cent. to that figure when the working pressure was 350 lb. per sq. in. He knew of no formula, empirical or otherwise, giving the proportion of standing losses on the increased pressure. The general opinion seemed to be that the boilers used in the new stations would be of the flash type, with no steam and water reserve. It appeared to him, looking at the matter from a station engineer's point of view, that that hand-to-mouth system of steam-raising would be dead against the continuity of supply.

Mr. R. J. Kaula said that the author was not very clear in his reasons for limiting the pressure to 400 lb. per sq. in. His remarks had been taken to mean that such a pressure could be adopted in existing stations provided suitable modifications were introduced. He did not think the author meant that, but in any case such modifications would be outside the range of practicable engineering. Increased pressure and temperature involved an increased risk of breakdowns, but without taking such risks there would be little progress. Raising the steam conditions meant increasing the turbine dimensions and cost in one direction and decreasing it in another, with the net result that apart from the question of materials there was not much to choose between the costs of the two designs. On the other hand, the two designs were essentially different, and if makers were to produce highly-efficient turbines for widely differing steam conditions, they would have to carry two sets of patterns for each standard output, which was a most serious handicap in the matter of cheap and rapid production. It would be an advantage if users could agree upon a standard steam pressure and temperature for new installations, such standard to be adhered to for a number of years.

Mr. F. Forrest said that one of the most serious considerations which arose when dealing with high pressures was the type of economiser to be used, and he thought the author had dismissed that important point with far too brief a reference. The pressure inside the economiser tubes was a pulsating one, which was greatly accentuated if reciprocating pumps were used, even though they were fitted with extra large air vessels, and the tubes were at the same time being subjected to external temperatures, probably as high as 500 or 600 deg. F. The physical properties of cast iron were such that at first sight one would condemn the use of this material for economisers. Future experience only would show whether cast-iron economiser tubes could be made as satisfactory at the higher pressures as they were

* Elec. Rev., July 26th, 1918.

† Elec. Rev., April 12th and October 4th and 25th, 1918.

at the lower pressures. The steel-tube economiser suffered under the disadvantage that the metal rapidly corroded unless means were adopted for completely de-aerating the feed-water. There would be a decided difference of opinion as to which type to adopt, and boiler insurance companies, as well as engineers in charge would watch this matter very carefully.

Mr. J. P. Kemp asked the author whether the overall efficiency of the boiler-house plant, assumed to be 77.5 per cent., was seriously put forward as a practical figure. In an extensive experience of modern boiler-house control he had not known such a result, and he thought that an average of 67.5 per cent. would more closely represent the average efficiency obtained in quite well-managed boiler houses at the present day. When one considered that most boilers had of necessity to be blown down (a little) daily, and entirely let down and emptied occasionally, for a variety of reasons, 77.5 per cent. appeared to be far too optimistic for average conditions, which was the only fair criterion. The highest average result he had known was obtained in a power station in Brazil, where the average for one particular month was 72.0 per cent., but the conditions were extraordinary. He very much doubted whether the author's figure of 77.5 per cent. average efficiency was practicable.

Mr. W. N. Y. King said that the scheme for high pressures was optimistic. From the profits shown there must be deducted various losses attendant on the use of the increased pressures. Auxiliary plant, which was as important as the main plant in large turbine lay-outs, would be considerably affected in design. With higher steam pressures auxiliary piping would be a source of greater care and loss of heat due to radiation, and was likely to involve more in upkeep of valves and lagging. The power required to drive the auxiliaries was estimated on too conservative a basis, even with highly efficient plant. It would have been more suitable had the power required been expressed in kw. instead of in b.h.p. in connection with technical electrical matters.

REVIEWS.

Power Plant: Installation, Upkeep, and Economical Installation. By Roland Wollaston. Pp. 117; 17 figs. 1918. Manchester: Sherratt & Hughes. Price 5s. net.

This little work is one that will be of great service to the owners, managers, and engineers for whom it is intended, and we venture to think that consultants and electrical engineers might often do worse than dip into it for hints and facts of value.

Men of all kinds are liable to idiosyncrasal obsessions on motive power which have no sound reasons behind them. A predilection for class in machines is like a fashion in ties and boots. The author before us possibly has such weaknesses himself, but, if so, he hides them well.

There can be rightly no fashion in motive power, for every situation has its own proper solution. Often the reasons for rival systems are so evenly balanced that two competent engineers may choose differently, but both will probably unite in rejecting all other systems but the two they have chosen. It is usually easy to decide that the choice must be either *a* or *b* if a man is an expert, but to non-experts it is difficult to decide between three or even four. Ordinarily there are seven systems to choose from, viz., steam, gas produced by the owner, gas from public supply, electricity from outside, electricity produced inside, by steam, by gas from outside, by gas produced inside.

To these seven may sometimes be added water power on the premises, or water power outside and brought into the premises electrically, also oil engines. Not all these systems are likely to be available at any one place.

Choice is usually to be based on cost. But cost, even when obviously low, cannot always rule. The lowest cost in every way may involve a capital expenditure beyond the owner's reach, and he may properly choose a method involving much more cost in the long run, because he has not capital to lay out. Thus it may be much cheaper to lay down plant and produce electricity on the premises than to pay the cost of a company's long mains, poor load factor, or profits on excess capital. But the external power station supplies from already sunk capital, and may help an owner to develop some new invention on some cheap site on which it would be folly to sink much capital in power plant.

Now the author is clear-sighted on these points, and sees in its proper perspective such a crazy procedure as putting in costly steam plant, with high economy engines, and extra boilers to generate steam for heating purposes. But it is not clear why we may expect soon to see almost all demands for power, light, and *heat* filled from big central stations. A central station as big as the moon could not distribute heat economically by way of electricity except for what may be termed drawing-room purposes, or purposes where the heat is kept in as in cooking or similar uses. But to warm a cotton factory which must be ventilated is quite a different problem, for a big stream of air is flowing to waste and removing the heat as fast as it is supplied, and there is precious little heat in the electricity produced by a pound of coal valued at 14,000 b.th.u.—perhaps 896 units; in rare cases even 2,000 units, or less than a third of the very poorest steam boiler heating efficiency. In fact, generally, factory heating at any distance from where the fuel is burned is a problem that cannot be airily dismissed, though the conveyance of heat from power stations has not received the attention here which has been given to it already in America.

It is unfortunate that even engineers who ought to know better are often apparently blind to the difference between heat in quantity and temperature, and to the difference between maintaining the temperature of a closed and insulated space and that of a free and ventilated space.

What the author has to say on gas power may be commended, especially in the matter of bituminous fuel, but he is a little off the mark in asking for positive blast for all suction gas plants independent of engine suction, especially if by blast he means the usual steam-blown jet, for much of the value of suction plant is the freedom from the steam boiler. For small work at steady loads there is apt to be no serious rival to suction gas, and if a town supply is available for possible emergency starting, the suction plant is easily first, for the engine can be started on town gas and the producer drawn up to activity by the running engine with its load on until finally and soon the producer is fully on and the town gas fully off. A producer may be blown, of course by the engine it feeds if a fan blower be employed, but is it really worth while?

One item of prospective weight should be noted. It has always been the mere commercial man's boast that he was entitled to do as he liked, even to wasting hundreds of tons of coal per year in order to make a £5 note extra profit. There is a tendency to-day, when we have lost already so many of our rightful and proper liberties, to limit our "right" to waste coal. No longer are men to pitch a thousand tons of coal into the cooling tower because it pays them to do so, or they think it pays them, or they pretend it pays them, because they are too lazy to take better care of shareholders' or taxpayers' money. But coal is a national asset, and it seems as though it were going to be soon as criminal to waste coal because one has the cash to buy it as it ought to be to trade coal or anything else with the men who sank the *Lusitania*. Coal is already controlled after a fashion. True, it is not well controlled yet, but some day the control may be managed by engineers who really understand the art and science of fuel economy. Then what about wasting coal to suit Tom's, Dick's, or Harry's notion of heat utilisation?

In Part II economical operation is dealt with, and useful charts are given as an aid to the comprehension of what becomes of the heat value of the fuel.

Part III is given over to the chemistry of water treatment, coal, and flue gas, and an Appendix treats of weir measurement of feed and condensation water. Altogether a very useful little work.

Works Lighting. By Daniel H. Ogley, B.Eng. Pp. 134; + 66 figs. London: Iliffe & Sons, Ltd. Price 7s. 6d. net.

Nobody will deny that the gospel of good lighting has still far to be carried before the lot of the worker and possibilities of output, so far as natural and artificial lighting are concerned, attain the ideal. As a popular work "Works Lighting" should assist in this propaganda to a large extent, but as a technical work for the assistance of the practical man or the illuminating engineer, it leaves much to be desired, and emphasises the fact that British practice is far behind American practice. Works by American writers on this and allied subjects are far beyond their English contemporaries; demonstrating that illumination is with the former the subject of thorough research, while here we are contented to copy and adapt.

In the first chapter generalities are touched upon, matter from sundry bulletins and publications being rewritten and presented in a collective form. An oft-produced chart showing the similarity between distribution of accidents and periods of darkness is shown; we are of opinion that too much stress is laid upon this, so far as it affects illumination pure and simple, and those making use of it should bear in mind that the period of cold weather also synchronises with the natural light curve, and will have a considerable bearing upon the accidents occurring. The need of cleanliness of the lighting unit is particularly emphasised, and the importance of this from the economic point of view clearly demonstrated. The characteristics of good lighting are then briefly touched upon, the discussion being largely based upon the report of the Home Office Committee on "Lighting in Factories and Workshops."

"The Development of Gas Lighting" makes interesting reading, but does not appear to be of great service. Certain figures relating to light deterioration of gas mantles are quoted; these figures are laboratory results, and the author expresses the opinion that "no doubt a considerable improvement is to be obtained in practice"; this is very much open to question, for laboratory conditions are usually far superior to those found in practice.

The illustrations showing gas lighting installations are poor and serve to show the advantages of electricity. Although entitled "Modern Practice in Gas Lighting," the next chapter is of general application, except in so far as a certain portion relates to high-pressure gas lighting. The author shows a lack of knowledge of the properties of reflecting surfaces, and misunderstandings are likely to occur if the statements at the opening of the chapter are taken too literally.

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We are glad to see that stress is laid on the fact that the height of suspension of a lamp has no bearing on the resultant illumination provided a suitable reflector is employed, a fact which is often overlooked. "Progress of Electric Lighting" forms the subject next dealt with, but again this is largely a reprint from manufacturers' pamphlets, and could have been presented in a more convincing manner by the inclusion of original matter and experience.

The measurement of illumination is next treated upon, indirect lighting is introduced, and the main types of reflectors are mentioned. Under the heading "Modern Electric Lighting" much that has already been stated is presented in a different manner, and mercury vapour lamps are brought to one's notice.

Chapter VIII deals with oil lighting, and one is impressed with its capabilities for situations where independent units are required or where the installation of gas or electricity would occasion undue expense, but at the same time the necessity for expert or semi-expert attendance cannot be ignored, for the inconvenience of priming and details of construction consequent thereon are enough to frighten any but the stoutest hearts.

"Natural Lighting" forms the subject of the last few pages; again general considerations are given, but the chapter serves to draw the attention of those responsible to the careful study which is desirable if the best results are required. We congratulate the author upon the introduction of this aspect into the book, for far too little attention is paid to the positioning of windows in factories, relative to the operations or work to be performed; with modern machinery top lighting alone is not always sufficient, so that adequate side lighting must also be provided.

The work closes with the table of "Cosines cubed" and an exceptionally complete index. The illustrations are, on the whole, good, but the method of numbering them chapter by chapter is awkward and cumbersome when one desires to refer back. The general setting out of the book is satisfactory, but for the information contained therein, the price appears to be excessive. One would have expected something better from the author of "Incandescent Lamps and their Applications," for the impression left after a careful reading of its contents is but poor.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

"Refills."

In the Electrical Review of the present week, on p. 545, in the legal column, there is a paragraph headed "Electric Lamp Refills." This is liable to do us an injury in our business. We shall be glad if you will kindly draw attention to it in your next issue. It should have read "Electric Battery Refills."

We have no connection or anything in any way to do with either of the two firms mentioned.

The Renew Electric Lamp Co., Ltd.,
F. Harrison,
Director.

London, N.W., *December 7th*, 1918.

[We are pleased to insert our correspondent's disclaimer, though we think his fears are groundless; there have been several such actions in connection with pocket lamps lately, and no one would be likely to confuse them with his firm's products. Nor do we agree that the heading should have been "electric battery refills"; the articles concerned were not refills for electric batteries, but refills for pocket or portable electric lamps.—Eds. Elec. Rev.]

Super-stations and Aircraft.

Many are the lessons this war has taught us:—

At the commencement we were told that aeroplanes were of no value; but now we know that they have played a most conspicuous part in terminating it. We were pleased 4½ years ago that they could take a few cwt. 200 miles, now we know they can easily carry tons as far as Berlin. What will they not be able to accomplish in another 4½ years? The 16 (more or less) super power stations which we are to gratefully accept as the cure of our present wasteful methods, will necessarily be huge, prominent, and conspicuous. The next time an enemy wants revenge, he will bomb these places to scrap heaps the day *before* he declares war. What then could we do with all our machinery standing idle? Imagine the chaos!

The men who said 4½ years ago that concrete ships would be sailing before the war was over would have been told to go and "sleep it off"; but we know that concrete ships are now sailing.

Electrically-propelled ships were scoffed at, and as for battle cruisers with turbo-electric drive of 150,000 kw., "well, the man must have bats in his belfry"; but all the same this is practically an accomplished fact.

For large power supplies, I know that if I had even a 15,000-kw. turbo-alternator and its boiler plant equipped with automatic stokers, superheaters, and economisers (such as most ships have not) fitted into a concrete barge and anchored near a dock, I should feel relieved. Her propeller when she was anchored would create a current for the circulating water, and also move her, when wanted, to another part of the system when the load centre of gravity demanded it. This would be easier than the usual laborious method of wayleave chasing.

Ash disposal would be easier than at present, foundation, unsuitable site, and building troubles eliminated. Costly circulating pipe runs not needed. No special coal bunkers required, a telpherage coaling scheme such as ships use at sea would be feasible either from docks or collier power-barges; equipped at makers' works, and delivered under steam and ready to work, in standard sizes.

In America a 200-mile transmission is not considered a particularly long one, and I know not, therefore, why it should be any more difficult here to transmit electric power over the same distance, but an 80-mile radius from any of the following waterways would cover any part of England, Scotland, or Wales: Thames, Wash, Humber, Tees, Tyne, Tweed, Firth of Forth, Caledonian Canal, Mersey or Dee, Bristol Channel, and Southampton Water.

Two or more 100,000-kw. barges at each of these points would solve a good many "burning" and bombing questions. In the latter case, the ships would be fairly difficult to distinguish from ordinary ones, and also they might not be at the exact spot expected when the bombers arrived.

Think it out further—"It's no sae daft as it micht luik."

C. T. Allan.

Cardiff, *December 4th*, 1918.

"Fraternity"—or Tyranny?

With regard to the remarks of your correspondent "Plain Speaking," and others—considering the staff engineers have been for so many years without any organisation whatsoever, why (when the E.P.E.A. is being put on a sound basis) should we want to rush into the arms of the E.T.U.? I think if all staff engineers would join the E.P.E.A., and thereby help the men who have done, and are doing, so much spade work, we should soon get the improvements in our working conditions which we all desire, without the help of the E.T.U. or anyone else.

S. A. Woodward.

Gloucester, *December 9th*, 1918.

In your issue of December 6th, "Plain Speaking" comes much nearer the mark in advocating what is practically the solution of the whole problem, viz., "*a strong union*," but states that the methods of the E.T.U. in the past have not altogether been to the liking of himself and fellow members.

He complains that an application by the E.P.E.A. for better remuneration has been turned down by various employers. As for methods, I can give many instances of men who joined the E.T.U., who, after doing so, and participating in the various advances, &c., &c., conceded to them through the E.T.U., have at the invitation, or, shall we say, command of their "chief," joined the E.P.E.A., because the "boss" is a member, and who, I feel convinced, would at the word of command put on overalls and become "stokers." Yet they ask for "fraternity." Who has refused it? Certainly not the E.T.U., which is open to all electrical workers, chiefs, and otherwise. By all means let us fraternise, and the course for the members of the E.P.E.A. is obvious. Cohere, and tyranny will cease to exist. United we stand—divided we fall.

William F. Wood.

Stockton-on-Tees, *December 9th*, 1918.

Wages and Working Conditions in Electricity Works.

I am desired by the Marylebone branch of this union to state that they, in common with the members of other branches of the Enginemen's Union interested in the rate card award, are far from satisfied with the net result. Though the men were told time after time that everybody would get something, complaints are so numerous as to no advance in wages being granted that there is a suspicion that the mixed nature of the work incidental to electricity undertakings has precluded the possibility of grading the men; the men, therefore, feel justified in asking for the abolition of these hybrid grades; and to benefit the lower hybrid grade men the introduction of a flat-rate wage of 8½d. per hour, or its equivalent for men on the weekly wage books, for *all grades* of work now rated at 8½d. or less. Committees have sat month in and month out for nearly two years to thresh out these wage rates, hoping for some substantial improvement to accrue as a result, but as their hopes are not realised the reaction is all the more violent. For eleven months past branches have been in constant session to answer questions, to advise generally, to confer with the representatives of other unions, and it is not nice to know that the work will have to be started all over again. This time, however, the men will not be found easy to satisfy, as they want entirely open negotiations.

As samples of the complaints coming in we may cite: Men are shifted from job to job, and are not paid the higher rates when shifted; men acting practically as higher-grade men—entered on wage books as lower-grade men in days gone by when grading didn't matter—now failing to obtain higher rates; coal trimmers doing ashing; the mains man doing meter fixing or meter reading or testing, or installation inspector's work; meter fixers' mates doing meter fixers' work; meter readers being made responsible for connecting and disconnecting at less than installation inspector's rates; day hands doing Sunday work are paid overtime, but shift hands doing Sunday work get no overtime; men completed a day's work and restarted same night without overtime pay; overtime payment for Sundays discontinued, and a bonus system introduced. All of these things seem to us to be needless complications. The men say they are determined to obtain a living wage without having overtime pay to make up for the shortage in other directions, and to obtain that living wage the branches will ask for an all-round advance of 4d. per hour, with an absolute minimum of 8½d. per hour, from which the 4d. shall be calculated. The members want the 47-hour week, which they are determined to press for. The delegates attending the conferences were asked to leave the 48- or 47- or 44-hour week in abeyance; but the engineering award becomes operative on January 1st; this award the members want applied to the electricity undertakings, together with the abolition of overtime; also they request the conversion of war wages and war bonuses into a permanent wage. The members further desire the abolition of piece rates and bonuses; also the minimum period of rest between any turn of duty shall be twelve hours (public breakdowns alone excepted); also the reinstatement of men returning from the Army or Navy to be carried through as expeditiously as possible, as it has been a great hardship for a man to do 1½ man's work per day. Hardships have been borne cheerfully for the sake of the brothers at the Front, and what sacrifices have been made as a war departure cannot now be made a permanent institution.

John Vincent,
Secretary,
National Amalgamated Union of Enginemen, Firemen, &c., of Greater Britain.

Smooth versus Undercut Commutators.

The following remarks will give your readers a brief outline of my experience with commutator troubles.

I have invariably had trouble with commutators caused either by inexperienced attendants or gross carelessness of those in charge of motors.

The general electrician in the first place fixes his brush position exactly in the centre of the main poles, and on tracing the lead of the armature one finds it may be out of the neutral position on a small machine by about 1 in. This is a frequent mistake, and I have been caused endless trouble through it.

The next thing is that one finds the brush-holders not equally spaced; a simple method of spacing them is as follows:—

Take a piece of paper and cut it to the width of commutator, place the paper tightly round the commutator, then mark off one complete radius of the commutator and take the paper off again. Now divide the paper into so many equal parts according to the number of poles, if a 4-pole machine divide the paper into 4 equal parts, if 6-pole divide into six, and so on.

This I have found is the most efficient way of spacing the brushes; some people count the number of bars on the commutator, and divide the number by the number of poles, and set the brushes accordingly. This method is wrong in cases where the mica and commutator bars vary in thickness, thereby giving a variation in the distance between the brushes, although the amount may be small it is nevertheless a fact. Now with regard to undercut mica, may I say that on a certain plant abroad I had over 100 motors, and after rectifying faults as stated above, I resorted to cutting down the mica on all machines, and in every case except one the experiment proved a great success, and fully justified my anticipations.

I may say that I cut the mica down 1/16 in. and insulated each section with a coating of very thin shellac, and it proved a greater success than any paste or filling that is used on such occasions.

With regard to the machine that did not prove a success, but certainly not worse, I may say it was a 20-H.P. motor, and had a great number of sections on the commutator, and we also had trouble with the oil creeping on the shaft and commutator.

Trusting these few remarks may be helpful to your readers, although it seems like treading over old ground, I should like to read other opinions on this subject.

Thos. R. Yearsley.

Birkenhead, *December 2nd*, 1918.

Referring to the correspondence in your November 29th issue on undercut commutators, I should like to give my experience, in the hope of helping on the great work.

I may claim to have a wide experience of all types of motors, such as tramway, crane, lift, workshop, and central stations, &c., and I have found in all cases that undercutting is beneficial, provided the slots are not too deep, because this allows an accumulation of carbon and grease which tends to put a short on the segments.

My worst experience was in a gas-engine station, where the fumes from the exhaust pervaded the engine-room, and played havoc with the windings and segments; I say windings because repeatedly we found an accumulation of dust behind the lugs, which seemed to absorb the gases, and caused a low-resistance fault between windings, and as the distances between windings and segments are appreciably smaller, the short soon took up the path of least resistance, viz., segments. We tried covering the lugs with stout shellacked canvas, but the result was not much better, and I firmly believe, sir, that the secret of success lies with the designer, who *must* study the conditions under which the machine is to work, viz., gas-engine station, flour mill, carbon works, &c., if, initially, the machine costs more it would pay in the long run. I would write more, but I think enough space has been taken up. Wishing you every success.

W. Parker,
Charge Engineer, Portsmouth Corporation.

Portsmouth, *November 30th*, 1918.

LEGAL.

The Fleming Valve.—Petition for Prolongation of Patent.

In the Chancery Division, on December 4th, Mr. Justice Sargant commenced the hearing of a petition, in the matter of Fleming's patent No. 24,850, of 1904, for prolongation of the patent.

Mr. J. Hunter Gray, K.C., and Mr. R. Moritz appeared for the petitioners; Mr. H. A. Colefax, K.C., and Mr. J. Whitehead for the British Thomson-Houston Co., Ltd., and others; Mr. Courtney Terrell for the De Forest Co., and Mr. T. Terrell, K.C., Mr. D. M. Kerly, K.C., Mr. Austen Cartmell and Mr. J. Whitehead for the Crown.

Mr. Gray said the invention was an instrument for detecting oscillations produced by energy generated some distance away in the form of Hertzian waves. The invention related to certain new and useful devices for converting alternating electric currents, and especially high-frequency alternating electric currents, or electric oscillations into continuous electric currents for the purpose of making them detectable by and measurable with ordinary direct-current instruments. Having read the patentee's claims in his specification, Mr. Gray said that the six opponents to the petition of prolongation of the patent were the Automatic Telephone Co., Ltd.; the British Thomson-Houston Co.; Creed & Co., Ltd., the Indo-European Telegraph Co., Ltd., Siemens Bros. & Co., Ltd., and the Western Electric Co., Ltd. These opponents alleged that there was no subject matter in the patent in question; that the invention was not of sufficient merit; that the petitioners had been amply rewarded for any ingenuity of labour or money they might have expended in respect of the invention; that the petitioners had had ample time and opportunity of putting the alleged invention into practical use on a commercial scale, and if they had not been adequately remunerated that was due to the petitioner's want of diligence, and, further, that the alleged invention was not useful. By clause 7 of the particulars of objection they admitted none of the allegations of the petitioners, and they traversed certain of them. Counsel, proceeding, said the petitioners alleged that the Fleming valve enabled signals to be received with certainty at distances much greater than was possible with any previously known detector, and it was now, and had been, some years in universal use all over the world for long-distance signalling; the Fleming valve had proved a more reliable and sensitive detector of wireless signals than any other, and its sensitiveness, unlike that of most detectors, was not impaired temporarily by violent atmospherical discharges, and thus its introduction marked an epoch in the development of long-distance wireless telegraphy, as it had led to the practical elimination of atmospherics, the magnification of signals, and new methods for the production of continuous waves.

The first witness called was Mr. John St.V. Pletts, chief of the patent department of the Marconi Co. He said that the magnetic detector came in in 1902, and it very rapidly displaced the coherer, which was very easily affected either by atmospherics or by one's own transmitters in the same stations. The magnetic detector still remained on many ships to-day. His company put the Fleming valve in ships because it was a more sensitive receiver, and it probably would have displaced the magnetic more rapidly had it not been that it was frequently burnt out by the operators using the filament at too high a pressure. He did not think that grid Fleming valves were put on board ship before the war. He knew of no other invention in connection with wireless telegraphy other than the 7777 that was so important. Great strides had been made since the

war in wireless methods and apparatus, and he did not think any of them would have been possible without the Fleming invention.

Cross-examined by Mr. Colefax, witness said that by Fleming valve he meant a valve which rectified by means of electrons. Before Fleming there had been no disclosure of the idea of using this valve, and that was an absolutely novel idea at the date of the patent.

(To be continued.)

Workmen's Compensation.

At the Bow County Court, on Friday, before his Honour Judge Graham, K.C., and a jury, Thomas Edward Knight, of 17, Cooper Street, Canning Town, sued the Charing Cross, West End, & City Electricity Supply Co., Ltd., to recover £300 damages for personal injuries, under the Employers' Liability Act, owing to an alleged defect in the plant.

Mr. Moyses appeared as counsel for the plaintiff, and Mr. Wickham, barrister, for the defence.

The plaintiff's case was that he was employed as a boiler scaler, and on June 20th, in the morning, asked for a brush and pail for his work. This was not forthcoming, so he went out on top of the boiler to fetch it. At that moment one of the tubes burst—they were water-tube boilers—in a boiler 50 or 60 ft. away, with the result that in trying to grope his way to safety in the blinding steam he fell off the boiler to the concrete floor below, a distance of 24 ft. He was very seriously injured, and had not recovered since. A juryman desired to know whether the insurers of the boiler had anything to do with defending the action, and whether the firm had had a number of similar accidents, but Judge Graham ruled that the questions were not permissible. The plaintiff said there were many men employed there who knew nothing at all about a boiler when they were engaged. He had no knowledge that three men and two mates were kept specially for the testing of these tubes. Had there been a guard on the boiler he could not have fallen off. He disagreed with counsel that he could not have been at his work to have been outside, as he had to go there to fetch his brush.

A mass of evidence was called for the defence to prove that every care that was humanly possible was taken to prevent such an accident, by testing, and the Board of Trade's most stringent regulations were fully carried out.

The jury gave a verdict for the plaintiff for £75 damages. Judgment was entered accordingly, with costs.

Electricity Supply in Cork.

In the King's Bench Division of the High Court of Ireland, before Mr. Justice Kenny, in the case of Meagher and Hayes *v.* the Cork Electric Tramways & Electric Lighting Co., Ltd., Mr. J. F. Burke applied, on behalf of the plaintiffs, for leave to deliver interrogatories to the defendants. Counsel explained that the action was brought to recover £101 8s. 5d., being the amount of overcharge paid by the plaintiffs, under protest and without notice, for a supply of electricity, contrary to the provisions of the Electric Lighting Act, 1882. The plaintiffs believed that electricity had been supplied to others in the same area on reduced and preferential terms, and they wished to administer interrogatories on this subject.

It was stated that the interrogatories had not been drafted, and Mr. Justice Kenny said the application could be renewed when that had been done.

Isaacs *v.* Hobhouse.

The hearing was concluded on December 5th in the Court of Appeal, consisting of Lords Justices Bankes, Warrington, and Scrutton, of the case of Isaacs *v.* Hobhouse, upon the application of the plaintiff, Mr. Godfrey Charles Isaacs, the managing director of the Marconi Wireless Telegraph Co., for a new trial of the action which was tried before Mr. Justice Darling and a special jury in July last.

Mr. Isaacs brought the action to recover from the defendant, Sir Charles H. E. Hobhouse damages for alleged libel concerned with the Marconi contracts for the construction of Imperial wireless telegraph stations.

The trial, which lasted eight days, resulted in a verdict and judgment for Sir Charles Hobhouse, and from this decision Mr. Isaacs now appealed, upon the grounds following: (1) Misdirection; (2) unsatisfactory conduct of the trial by Mr. Justice Darling; (3) wrongful exclusion and inclusion of evidence, and (4) surprise.

Mr. J. A. Hawke, K.C., Mr. Stuart Bevan, and Mr. Hildesley appeared in support of the appeal; and Mr. Douglas M. Hogg, K.C., and Mr. Eustace Hills for the respondent.

At the conclusion of the arguments of counsel for the appellant, and without calling upon counsel for the respondent, their lordships dismissed the appeal, with costs, holding that there had been no such misdirection by Mr. Justice Darling as would justify the Court in setting aside the verdict of the jury. They also held that the appeal failed upon the other grounds enumerated in the notice of appeal.

A stay of execution with the view to an appeal was refused.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Northrup-Ajax High-Frequency Induction Furnaces.

The Pyrolectric Instrument Co., 636-640, East State Street, Trenton, N.J., is now marketing the Northrup-Ajax high-frequency induction furnace, to which we drew attention some time ago, which is adapted in small units for laboratory use and scientific investigations. These furnaces present a radical departure from the usual furnace practice and embody the first employment of oscillatory current for the generation of heat. By reason of the possible induction without the interlinkage of an iron magnetic with an electrical circuit, currents can be set up in the containing crucible in the case of a non-conducting melt, or in the melt itself if this has sufficient conductance to permit the flow of currents. No iron is employed for the concentration of magnetic lines of force. The furnace is intended for single-phase operation, and the thermal efficiency is said to range from 40 to 60 per

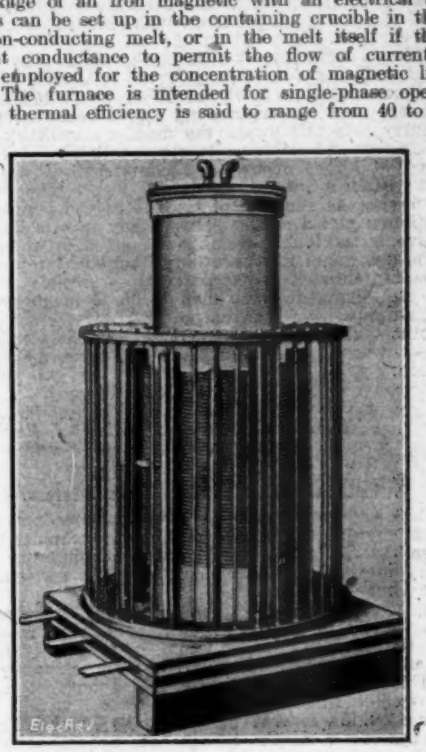

Fig. 1.—Northrup-Ajax High-frequency Induction Furnace of the Standard Vacuum Type.

cent. of the power input at the switch terminals. The complete equipment includes the following parts, some of which are omitted on the smaller size of furnace: Switchboard, series reactance with tap-off points, one shunt reactance, one transformer with windings for primary voltage of 110 or 220 volts, condenser units, condenser rack, mercury discharge gap with alcohol dropper and mercury adjuster, furnace, and a set of heavily insulated cables leading from the oscillatory system to the furnace. The furnaces may be used for the heat treatment of metals, for making special alloys, for melting glass and non-conducting materials, for producing temperatures above 1,400 deg. C. without the presence of carbon being essentially associated with the operation of the furnace, for producing higher temperatures under controllable conditions of vacuum or pressure and nature of atmosphere, or for other like uses. They are made in five sizes: 6-, 8-, 12-, 16-, and 20-kw. capacity.

A Combined Electric Heater and Cooker.—With reference to our notice of this device in these columns last week, we understand that the B.E. Co. (of London and Birmingham), Ltd., 410, Mansion House Chambers, Queen Victoria Street, London, E.C. 4. acts as London agents for this device, and carries stocks of all styles and voltages both at the London and Birmingham stores.

For Disabled Soldiers.—There has been issued by the Ministry of Pensions, Westminster House, Millbank, S.W. 1, a most useful series of little pamphlets in which full pension and other particulars are given in handy form. An illustrated one, written by Major R. Mitchell, C.B.E., on the advantages of training for a future career, contains the testimony of a number of disabled men who have been satisfactorily trained for successful work in electrical and other directions. "The Disabled Soldier's Handbook, 1918" (32 pages), given to every man on his discharge, is a useful guide to a host of matters.

BRITISH-MADE A.C. METERS.

By H. COBDEN TURNER.

With the cessation of hostilities, we may expect a return of the competition between British and foreign meters, perhaps not in this country, but assuredly in the Colonies and Neutral Countries. The following results of tests and deductions therefrom may not, therefore, come amiss at this time.

It is probably not generally known that the British-made induction motor meters, as contrasted with the Continental meters—chiefly German and Swiss—fall into quite a different class, by reason of a fundamental difference of design—namely, the disposition of the series and potential coils.

A.C. meters of British origin have, with one exception, separate magnetic cores for the fluxes produced by the pressure coil and the series coil. This is not generally the case in meters manufactured on the Continent, where, with one exception, they possess only one core for both series and shunt fluxes. This core has three limbs—the outer two generally being wound with shunt coils and the middle one with a series coil. The fluxes are led through the disk by means of an iron keeper on the reverse side of the disk. Meters of the latter construction do not stand overloads well, and, in fact, are generally unsuitable for any condition other than the normal one for which they were calibrated.

Two typical forms are shown in attached sketches figs. 1 and 2. The obvious result is that home-made meters are, almost without exception, larger, and, consequently, heavier, than Continental meters, but, in electrical performance, the British method by far excels the other.

The following table shows the comparative results obtained on various well-known meters with variations of voltage. The first four are British and the last four Continental:—

With 50 % Increase of Pressure.

British.			*Continental.*		
A ...	− ½ %		W ...	− 16 %	
B ...	− 3 %		X ...	− 16 %	
C ...	− 3 %		Y ...	− 3 %	
D ...	− 3 %		Z ...	− 30 %	

With 50 % Decrease of Pressure.

A ...	− 0		W ...	− 3 %	
B ...	+ 1 %		X ...	+ 3 %	
C ...	+ 1 %		Y ...	+ 1 %	
D ...	+ 3 %		Z ...	+ 20 %	

− sign represents that the meter was running slow.
+ means fast.

Similarly with variations of frequency:—

With 40 % Increase of Frequency.

A ...	− 3 %		W ...	+ 1 %	
B ...	− 1 %		X ...	+ 5 %	
C ...	− 6 %		Y ...	− 2 %	
D ...	− 5 %		Z ...	+ 8 %	

With 40 % Decrease of Frequency.

A ...	+ ½ %		W ...	− 10 %	
B ...	− 3 %		X ...	− 33 %	
C ...	+ 1 %		Y ...	− 15 %	
D ...	− 4 %		Z ...	− 47 %	

With 40 % Increase of Frequency—P.F. 0·5.

A ...	+ 3 %		W ...	+ 8 %	
B ...	+ 4 %		X ...	+ 21 %	
C ...	+ 5·2 %		Y ...	− 3·0 %	
D ...	− 5·8 %		Z ...	+ 15·7 %	

With 40 % Decrease of Frequency—P.F. 0·5.

A ...	− 12 %		W ...	− 22 %	
B ...	− 12 %		X ...	− 87·5 %	
C ...	− 14 %		Y ...	− 26·6 %	
D ...	− 25 %		Z ...	− 71·8 %	

The figures are based on variations at half-load.

It might be opined that these variations are severe, but the purpose in this was to accentuate the errors, which will be proportional for small and more ordinary conditions of change. Also, small changes of wave form, such as are found to occur in ordinary practice, are quite comparable with large changes of frequency, seeing that they are caused by the presence of the higher harmonics.

Comparison of Construction.

Terminals.—In the terminals and connections from the terminals, and in the gauge of wire used for the various coils, it will always be found that the British-made meters are more liberal in section than the Continental.

Cases and Covers.—These on British meters are generally of pressed steel or cast-iron, giving a protection to the meter from external fields such as is not acquired by means of the jointed spelter or zinc covers used on the Continent.

Watt Consumption.—In this respect the two types are approximately equal, as the following figures will show:—

Shunt-coil Losses.

A ...	...	1·4 watts	W ...	...	2·4 watts
B ...	...	1·4 ,,	X ...	...	1·5 ,,
C ...	...	1·5 ,,	Y ...	...	1·2 ,,
D ...	...	2·5 ,,	Z ...	...	1·2 ,,

Torque.—As regards the torque developed, either type can, of course, be made to give practically any value of torque by increasing the number of turns on the series coil, increasing the air gap in the shunt magnetic system, placing the motor system a greater distance from the centre of the disk, &c.; but the limiting factor is the brake magnet, because it is an axiom of A.C.-meter design that the speed of the disk should not exceed 50 R.P.M.

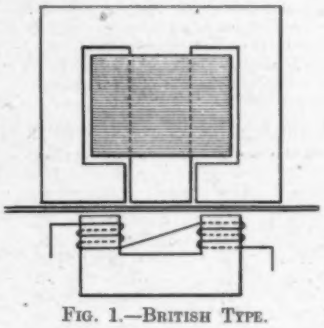

Fig. 1.—British Type.

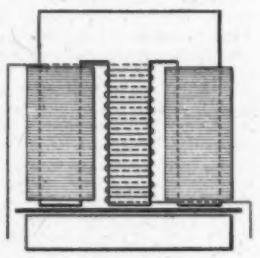

Fig. 2.—Continental Type.

In other particulars no sharp difference between the two makes can be defined. Prevention of shunt-running is obtained variously by provision of holes in the disk or by means of the attraction of the permanent magnet for a particle of iron inlet in the disk, or a piece of iron wire extended from the spindle. Similarly, better values of starting current and registration on low loads are obtained by causing the shunt leakage flux to be laterally unbalanced by a variety of means.

New Electrostatic Separator.—The principal feature of the Bibolini-Riboni separator is in the form given to the electrostatic field. This field is generated by a number of electrified cylindrical polar surfaces arranged in parallel groups, situated at different levels. Each one of these cylinders, considered together with the polar plane facing it, generates an element of the electrostatic working field, and is intended to operate on a portion of the triturated mineral (mixed with a number of other minerals and gangues) which is either passed across it by a conveyor band moved at a uniform speed and sliding on the induced polar surface, or is allowed to gravitate on to the plane polar surface, suitably inclined and prepared. The crushed ore is fed into the transporter (or on the plane polar surface) by as many feed buckets as there are electrifiers in a group on one level, and thus forms on the belt or on the pole which receives it as many bands of constant thickness and breadth as there are separating units. The action of each unit on this band of material is to project in a direction lateral to the axial plane of its own field, the granules forming the mineral mixture. During this operation separation is effected in that one or a number of qualities of the granular constituents of the mixture tend to keep in the central zone of feed, while the others are projected into the zones lateral to this central zone. The products thus separated are treated similarly in the other stages lower down, until separation is complete. To graduate the process the apparatus is provided with several devices which constitute special features of the method: *e.g.*, it is possible (1) to vary the geometric shape of each electrostatic field element by varying the curvature of the electrifying units and their position relative to the polar surface opposite; (2) to vary the conductivity of the plane pole; (3) to vary the period of electrification by varying the speed of the conveyors and the angle of the surface of descent of the granules.—*L'Industria.*

BUSINESS NOTES.

The Christmas Holidays.—We shall be glad if our readers will take note that, owing to the Christmas Holidays, the Electrical Review for December 27th will have to be printed two days earlier than usual. All matter intended for that issue, whether editorial or advertisement, should be in our hands at the earliest possible moment. From a notice appearing elsewhere in our pages to-day, it will be observed that all new advertising copy and alterations to existing displayed advertisements must be received here not later than the morning of Friday next, December 20th. Official Notices and small prepaid advertisements can be received up to the following Tuesday morning.

Activity of Foreign Firms in Denmark.—H.M. Commercial Attaché at Copenhagen emphasises the importance of British firms preparing at once for the competition they will shortly encounter in Denmark. A number of Danish firms have inquired from him whether there would be any possibility of placing orders with British firms now for goods to be delivered after the conclusion of peace. They state that foreign firms are canvassing for orders to the detriment of British industries. The firms who have approached him have previously bought their requirements from British firms, and they are loath to pass their orders to other countries, should there be a reasonable chance of obtaining supplies from the United Kingdom within a reasonable period. He suggests that the question be considered whether British firms would not be well advised to book orders for delivery so soon as conditions permit. In the present circumstances, where neutral markets are bare of goods, merchants are anxious to place orders, even though they realise that considerable time may elapse before they can be executed. Some foreign houses appear readily to accept such orders, with the result that the merchants in many cases, having once placed orders in those countries to cover their requirements, these are lost—for the time being, at any rate—to the British market.—*Board of Trade Journal.*

Export Prohibitions.—A further list of relaxations in export prohibitions, announced by the Board of Trade to take effect as from to-day, appeared in the *Board of Trade Journal* for December 5th.

Indian Government Contracts.—The Report of the Public Works Department Reorganisation Committee in British India contains important material to United Kingdom firms which have been executing contracts for the Indian Government. It deals with the present system of purchasing stores through the India Office, and advocates that greater latitude shall be given to Public Works officials in obtaining material in India. The tendency will be more and more to cut away from the London connection, and to call for more and more tenders in India. If British manufacturers are to continue to retain the same proportion of these public orders as they have secured in the past, says the *Board of Trade Journal*, they will be obliged to open their own branches in India and operate them with a trained staff, and also—in the case of manufacturers of large plant—with a competent erecting staff.

The Report may be consulted by interested British firms at the Inquiry Room of the Department of Overseas Trade (Development and Intelligence).

Tasmanian Electrolytic Zinc.—At Risden, Tasmania, the Electrolytic Zinc Co. is producing 90 tons of high-grade zinc weekly.—*Times.*

The "Paragon" System in France.—Capt. Lucien Fialon, the representative for France and the French Colonies of the "Paragon" inventions of Mr. W. P. Durtnall, was awarded the Croix de Chevalier de la Legion d'Honneur on July 10th last. Capt. Fialon was one of the first Continental engineers to investigate the merits of Mr. Durtnall's system, and is about to apply the "Paragon" internal combustion cycle to large 7-ton commercial lorries, &c.

Reconstruction Problems.—Two more of the series of pamphlets on reconstruction problems have been published (2d. each) by the Ministry of Reconstruction. No. 6, entitled "Raw Materials and Employment," shows how the supply of raw materials is a fundamental point in the work of demobilisation, resettlement, and industrial revival. It covers briefly the bearing of the question on metal industries, textile industries, and the boot and shoe industry, timber, paper-making, &c. The importance of preventing a general scramble for available supplies has led the Government to the conclusion that there must be some measure of Government control or supervision, and the Departments that have been chosen to exercise this control and to arrange for distribution through trade organisations—Industrial Councils or Committees in each industry—are described. Pamphlet No. 7 is a "Guide to Work and Benefits for Soldiers and Civil War Workers." The part relating to the fighting forces, deals with such matters as gratuities for service, "how to get a job," out-of-work donation, a Bill to be introduced giving State assistance to apprentices whose training has been interfered with by the war, openings in the Civil Service, training, civil liabilities, and grants to one-man businesses which have been closed but not given up. The remainder of the pamphlet relates to munition and other war workers.

Australian Copper Wire Works.—It is reported from Newcastle, New South Wales, that an English company, with £5,000,000 capital, intends to establish works for smelting copper and the manufacture of copper wire.—*Times.*

Samples of Foreign-Made Goods.—The Exhibition of samples of foreign-made goods received from various parts of South and Central America, which was held in Birmingham from November 27th to 29th, has proved very successful. This Exhibition was organised by the Department of Overseas Trade with the co-operation of the Birmingham Chamber of Commerce. The number of firms, or representatives of firms, who inspected the samples during the period of the Exhibition was 925.

Many of the articles exhibited were new in design, and represented selling lines in the South American markets.

A similar Exhibition is being held in the Cutlers' Hall, Sheffield, closing to-morrow.—*Board of Trade Journal.*

Book Notices.—*Decimal Educator.* Vol. I, No. 2. December, 1918. Pp. 32. London: The Decimal Association. Price 1s.—It is a pleasure for us to welcome the second issue of such an excellent pamphlet, which is voicing a keen desire which has always been expressed for the general use of decimal currency and metric weights and measures. We cannot do better than hope that it may meet the same fate as its predecessor—a wholly satisfactory one. The current number maintains the same high standard as the previous one, and we note an improvement in that it is printed in larger type. It contains an account of the general meeting of the Association, and the new rules which were then adopted. The progress that has been made by the Royal Commission on Lord Southwark's Decimal Coinage Bill is also recorded, and articles appear on the following subjects:—"The Adoption of the Metric System," "The Teaching of Decimals," "British Trade After the War," "Measurements in Engineering Works," and other interesting matter. To those who contemplate possessing themselves of a copy we would recommend early application. Judging by the demands that, we understand, were made for the previous issue, the present one will be out of print as quickly as, if not quicker than, its predecessor.

Pitman's Mechanics' and Draughtsmen's Pocket Book. By W. E. Dommett. 1918. Pp. viii + 127. London: Sir Isaac Pitman and Sons, Ltd. Price 2s. 6d. net.—This pocket book has been drawn up with a view to the requirements of mechanics, foremen, draughtsmen, and similar grades who have to use tables and occasionally to employ the more general mathematical problems in the course of their work. The notes and diagrams are not intended to take the place of text-books, but they will be found of use together with the tables, particularly those at the latter end of the book, to act as a means for refreshing the memory when necessary.

A New Theory of the Steam Turbine. By H. M. Martin. Reprinted from *Engineering.* Pp. 22; 10 figs. London: *Engineering.* Price 2s. 6d. net.—The rapid development of the steam turbine has been largely attributable to the circumstance that, from the standpoint of thermodynamics, it is a much simpler form of prime mover than the reciprocator. With the steam turbine theoretical considerations are more directly applicable, and a fairly reliable estimate can be made of the probable performance of most types of turbine of which the drawings are available. Nevertheless, experience disclosed some remarkable anomalies, some of which have not, until recently, been elucidated. One of the most disconcerting was the well-established experimental result, that under certain conditions the weight of steam discharged from a nozzle was actually greater than what was physically possible according to the then accepted theory. The anomaly was attributed to a fundamental error in the accepted theory of the efflux of steam. That theory assumed that the expansion of wet steam normally proceeded under conditions of thermal equilibrium, although the falsity of that hypothesis was definitely proved as far back as 1880. The author of the articles before us gives what appear to be very strong reasons for believing that another great outstanding anomaly in steam turbine engineering is to be traced to the same error. Actual experience, in short, affords much weighty evidence in favour of the view that so far from the steam being in thermal equilibrium in the "saturated field" of the Mollier diagram, it never is in thermal equilibrium until the condenser is attained. The relation between volume and pressure during the expansion of wet steam is accordingly never the same as if thermal equilibrium were established. The author endeavours to show that if his interpretation of Wilson's results be accepted, both superheat and vacuum corrections can be rationalised, whilst the contrary view involves wide discrepancies between theory and practice.

"The Manufacture of Aluminium." By J. T. Pattison. 1918. Pp. viii + 104; 18 figs. London: E. & F. N. Spon, Ltd. Price 7s. 6d. net.

"The Craft of Thy Caduceus." By "Exact Thinker." London: 6, Walton Place, S.W. Price 5s.

War Risks: Cargo Insurance.—On December 9th the granting of fresh insurances on cargo against war risks by the War Risks Insurance Office was discontinued, except in special cases. It is the desire of the Government to restore as quickly as practicable the normal conditions of the insurance market.—*Board of Trade Journal.*

Trade Announcement.—I. A. Timmis & Son.—The Government having requisitioned their premises, the firm's temporary address is now 16, Eaton Square, Westminster, S.W. 1. Telephone: Victoria 481.

Siemens in Australia.—A Melbourne newspaper stated, early in October, that branch offices of Siemens Brothers' Dynamo Works, Ltd., in Melbourne and Sydney had been reopened for trading. "By the action of the British Government, the German interest has been completely eliminated from this company, and the Australian Government has removed the embargo against its operating in the Commonwealth."

Foreign Trade.—The November Figures.—The official returns of imports and exports during last month contain the following electrical and machinery figures :—

Imports.	November, 1918.	Inc. or dec.	11 months, 1918. Inc. or dec.
	£	£	£
Electrical goods ...	90,506	− 32,561	− 245,471
Machinery	1,026,811	− 2,699	+ 1,735,110
Exports:			
Electrical goods, &c. ...	144,313	− 64,904	− 856,799
Machinery	1,211,690	−290,785	− 3,318,340

"Z" Lamp Club.—A social and athletic club has been formed for the staff and workers of the "Z" Electric Lamp Manufacturing Co., Ltd., at Southfields, S.W. We have received a copy of the fixture card of the football section, which last week played a match, resulting in a draw, with the "Magnet" Football Club, as mentioned below.

Football Notes.—On Saturday last a football match, resulting in a draw (2—2), was played at Dulwich between the Magnet F.C. and the "Z" Electric Lamp Manufacturing Co. The "Magnets" were the first to score through a good shot by Terrett, but soon after Driver ran through, and scored for the "Z's," and a few minutes later registered his second goal with a fine shot; just before half-time, however, Dyke equalised for the "Magnets." The second half was very evenly contested, and there was no further addition to the score.

Liquidations.—English Electrical Co., Ltd.—This company is winding up voluntarily, with Mr. J. B. Brent, of 3, Abchurch Yard, E.C., as liquidator. Meeting of creditors December 16th.

Chester Engineering Co., Ltd.—Winding up voluntarily. Liquidator, Mr. S. Cole, of Sardinia House, Kingsway, W.C.

New Electrical Finance Company.—Mr. C. S. Colton, for many years export manager for the British Westinghouse Electric and Manufacturing Co., Ltd., has transferred his activities to a new field of enterprise, having recently taken up the position of managing director of the Aabada Trust, Ltd. This company, which was established in 1912, undertakes the finance and construction of public utility works, electrical apparatus, inventions and designs, and general engineering propositions. Mr. Colton has secured for his organisation an expert technical staff, comprising the well-known firm of Messrs. Alfred Dickinson & Co., as consulting engineers, and Mr. J. W. Towle, M.I.E.E., as chief of the company's engineering staff. Mr. Towle was formerly superintendent for the Metropolitan District Railway and the London Electric Railways, and chief engineer to Ebro Irrigation Power Co., of Barcelona. Amongst the new enterprises which Mr. Colton hopes to put on the market immediately is the Aabada dry battery.

German Share Quotations.—It is now possible to give a comparison of the quotations for the shares of a few of the leading German manufacturing companies, as represented by the situation at the end of July, 1914, the end of June, 1918, and in November, 1918. The final making-up prices on the Berlin Exchange before the war were settled on July 31st, 1914, and although the publication of quotations has been forbidden in the meantime, and no official transactions have been permitted, business was done in what is termed an "open market." The accompanying table shows the official prices on the Berlin Exchange on July 31st, 1914, whilst the figures for the two other dates are those which were either quoted in the open market or made up on the day in question :—

	Quotations on— July 31st, 1914.	June 30th, 1918.	Nov. 7th, 1918.
Berlin-Hagen Accumulator Co.	252·00	410·00	247·50
A.E.G.	210·00	249·10	223·50
Bergmann Electricity Works...	90·00	216·50	173·00
Schuckert Co.	118·75	164·25	142·00
Siemens & Halske	192·00	239·10	211·00

The par value is 100 in each case. It will be observed that an extraordinarily large rise took place down to and including the period of the German offensive early this year, the figures on June 30th being the maximum attained during hostilities. Later on, however, the quotations crumbled away, and the prices given for November 7th are those which were made up on that day, for the last time prior to the revolution.

New Company in Spain.—Under the style of Auxiliar de Explotaciones Electricas, Compania Anonima, has been formed at Bilbao a company with a capital of 30,000 pesetas, for the manufacture, purchase, sale, and representation of all kinds of electrical machinery and accessories.

New Companies in France.—La Société le Materiel General Electrique is the name of a new company which has lately been formed in Paris (15, Rue des Petits Hotels), with a capital of £19,200, to carry on business as electrical engineers.

Under the ægis of a number of leading French motor-car manufacturers a company has lately been formed in Paris, with the title La Société Francaise des Appareils Delco, to acquire and exploit the exclusive manufacturing rights in the Delco (American) electric lighting and engine-starting sets in France and the French Colonies.

Catalogues Wanted.—The Cark and District Electric Supply Co., Ltd., of Flookborough, Cark-in-Cartmel, Lancs., desire to receive catalogues of wiring supplies, small country house plants, and electrical supplies generally.

Exports to China.—The *London Gazette* for December 10th contains a further list of persons and bodies in China to whom exports may be consigned.

New Swedish Electrode Company.—The Aktiebolag Elektrod is the title of a new undertaking which has lately been formed in Falun, with a maximum capital of £55,500, to manufacture electrodes in accordance with the patented process of C. W. Soderberg.

Australian Industrial Development.—A certain amount of industrial and manufacturing development in the Commonwealth was disclosed by the Commonwealth Treasurer in his Budget speech. At the beginning of 1916 the issue of capital by companies became subject to Treasury control under the war precautions regulations. Since that time the applications received number 4,347 and the capital authorised amounts to £50,585,000, of which £30,099,000 was capital permitted in relation to "manufacture and production." The detailed figures include manufacture of foodstuffs, £4,163,000; iron and steel works and smelting and treatment of metals, £4,156,000; gas and electric light, £1,781,000; engineering and metal working of all kinds, £1,560,000; rubber goods, £1,196,000; apparel and textile manufacture, £932,000; lime and cement production, £858,000; tanning, wool scouring, and spinning, £723,000; drugs and chemicals, £368,000; paint manufacture, £436,000. Under the heading of other manufacturing and producing industries capital to the amount of £3,288,000 was included.—*Melbourne Age*, October 3rd.

Australian Copper Industry.—According to a Melbourne newspaper just to hand, the outlook in regard to Australian copper industry was seriously regarded at the end of September. In view of the fact that the price of copper in America was £140 a ton, Mr. Blakeley (N.S.W.) asked the Acting Prime Minister in the House of Representatives to enter into negotiations with the Allies for the sale of the products of Australian copper mines after the expiry of the present contracts with Great Britain. The Acting Prime Minister said he would not like to promise that. The Government thought that in the past it had been acting in the best interests of the Allied Forces when it had sold to Great Britain the output of such minerals as lead, zinc, copper, and certain other metals. The Government had all the time been conscious that in certain cases the prices ruling in the open markets of the Allies had been higher than the contract prices, but it had been considered advisable to sell to Great Britain even at some slight disadvantage to Australian producers, rather than sell outside. He could name metals in regard to which the American prices were higher than the prices at which Australian metals had been sold to the British Government. The Americans dominated the copper position, but it was not so with other metals. The Prime Minister had recently had the greatest possible difficulty in securing a renewal of the contracts even for six months. He would communicate with Mr. Hughes, to see whether it was not possible to extend the contract or to obtain more favourable terms. Unless something were done, some of the mines would be affected at the end of October, and the Government would have to make some arrangements for financing them. If the Government was not able to extend the contracts on some decent, favourable terms, he realised that there would be a greater danger facing the great copper industry of Australia.

Ministry of Munitions Orders Revoked.—The Cranes Order, 1916, and the Motor Engines and Vehicles Order, 1917, have been revoked.

Relaxation of Priority for Government Work.—The Minister of Munitions hereby gives notice that all uncompleted contracts for the Admiralty, War Office and Ministry of Munitions which have been placed in Classes A or B, including the various grades thereof, P 1, P 2, P 3, P 4, P 5, P 6, under the Order as to Priority of March 8th, 1917, need no longer be given the priority attaching to them under the Order, except in cases where the contractor is notified in writing or by official notice in the Press that a particular classification is still required to be given to any particular contract.

Contractors must notify the ordering Departments of the Admiralty, War Office or Ministry of Munitions responsible for the contracts in question, of any modification of the original date of completion resulting from this relaxation of the Order as to Priority.

Mr. Barnes and Nationalisation.—In one of his recent speeches to Glasgow electors, Mr. Barnes said he looked forward, as the result of nationalising railways, to an immense stimulus to this country's industries, and along with it, he believed, they ought to develop the canal system to a much greater extent than hitherto. As soon as possible the national workshops should be led on to the making of rails, locomotives, and all that was necessary to run railways into undeveloped parts of the country, and thus bring produce into the market at a cheaper rate. The nationalisation of railways and canals would be one of the main things to put industry into a better position than ever. He also hoped that national factories would be retained as far as possible for productive work for peace as they had been used for war. They should be speedily turned to all sorts of things necessary for housing, for railways, and for the equipment generally of Government enterprise.

French Foreign Trade.—Last month, says the *Times*, M. Clémentel, French Minister of Commerce, laid before the Chamber a Bill dealing with the reorganisation of the nation's foreign trade. The number of commercial attachés abroad is to be increased.

LIGHTING AND POWER NOTES.

Accrington.—Year's Working.—The income of the Corporation electricity department for the year ended March 31st, 1918, was £41,127, compared with £35,775 in the preceding year; the expenditure was £27,743, against £34,064. Capital charges absorbed £10,929, against £11,242, and the net profit for the year was £2,777. The undertaking is now indebted to the rate funds to the extent of £21,724. Units generated totalled 7,777,745, and 6,459,900 were sold, including public lighting, 19,689; private lighting, 370,794; tramways, 816,884; power, 4,539,217; and Haslingden bulk supply, 560,880. The supply to Haslingden was at '74d. per unit, against 823,005 units at '7d. in the previous year. The working cost per unit sold was 1'03d., against 1'14d., and the total cost, 1'44d., against 1'516d.; the average price obtained was 1'44d., against 1'1d. During the year the number of consumers decreased from 1,457 to 1,429.

Armagh.—Strike.—The supply of electricity was suspended last week, owing to a strike at the electricity works.

Belfast.—New Generating Station.—At a meeting of the Electricity Committee, last week, it was stated that plans for the new generating station were nearly completed, and the Committee expected to be in a position to invite tenders for the erection of the new buildings at an early date. With a view to laying out the distribution system to the best advantage, prospective customers have been asked to communicate with the electrical engineer, and the data so obtained would enable the substations to be placed in the best positions. The Corporation was under obligation to supply a further 20,000,000 units per annum, and it was expected that in two years' time the annual output would not be far short of 50,000,000 units. A breakdown of one of the turbines was reported, and an inquiry is being held into the matter.

Bexhill.—Price Revision.—The T.C. has abandoned the maximum demand system of charging for electricity and adopted a flat rate. For power the rate is to be 2d. per unit, and in all cases a special war charge of 25 per cent. is to be charged.

Blackburn.—Price Increase.—The charges for electricity for all purposes are to be increased by a further 15 per cent. from January 1st next.

Bolton.—New Mains.—The Corporation has received the sanction of the L.G.B. to borrow £1,500 for the laying of a main between Back-o'-th'-Bank generating station and the Duncan street sub-station.

Bury.—Year's Working.—For the year ending March 31st, 1918, the working of the Corporation electricity undertaking resulted in a net profit of £1,626, against £2,668 in the previous year, of which £626 was transferred to the reserve fund and £1,000 to the relief of rates. The revenue totalled £50,776, against £46,596, and the expenditure amounted to £33,674, against £29,447. The number of units sold during the year was 14,544,937, against 13,971,547, and included private lighting, 500,702, against 523,480; public lighting, 12,733, against 11,044; power and heating, 8,650,324, against 8,714,355; bulk supply, 3,667,603, against 3,054,194; and tramways, 1,712,752, against 1,665,652. The maximum load was 5,152 kw., against 5,027 kw., and the load factor, 32'4 per cent., against 31'7 per cent. The generating cost per unit was '555d., against '506d., and the total cost, '810d.; the average selling price was '837d. The cost of coal increased from '281d. per unit to '31d. During the year, £3,034 was expended on the Chamber Hall power station and £851 on new mains and transformers. Since the inauguration of the undertaking, £11,500 has been transferred to the borough fund. Owing to the fact that the largest generating set was out of use for four months, the fuel consumption per unit increased from 2'95 lb. to 3'11 lb.

Chertsey.—Price Increase.—The B. of T. has agreed to the application of the E.S. Co. to increase its charges from 7d. to 8d. per unit, from January 1st next.

Croydon.—Wages.—The Electricity Committee has received the award of the Committee on Production, affecting all employés at the electricity undertaking. The award takes effect from August 19th last, and provides for a 56-hour week, 14 days' holiday after one year's service, and fixes special rates for overtime and public holidays.

Dublin.—Loan Sanction.—The L.G.B. has sanctioned the borrowing by the Corporation of £60,000, to provide working capital for the electricity undertaking.

Electric Tanning.—Application has been made to the Corporation for a site at the North Wall (Quayside), for premises for the treatment of 4,000 hides per week, by Dr. Groth's electric tanning process.

Threatened Strike.—The Corporation having refused to ratify the report dealing with the agreement regarding the wages of the members of the Irish Association of Electrical Station Engineers employed by the electricity department, the men concerned intimated their intention to cease work on December 9th if the matter was not settled. However, a special meeting of the Corporation empowered the E.L. Committee to deal with the matter in accordance with the agreement, and the strike notices were suspended.

Eccles.—Price Increase.—The T.C. has increased the price of electricity, for all purposes, by a further 25 per cent., a total war advance of 75 per cent., from the end of the present quarter.

Halifax.—Proposed Loan.—The T.C. has applied to the L.G.B. for sanction to borrow £9,021, for the purchase of a boiler and economiser for the electricity works.

Harpenden.—Proposed E.L.—The Luton T.C. is considering the question of extending its electricity supply to Harpenden.

Harrogate.—Year's Working.—For the year ended March 25th, 1918, the income of the Corporation electricity department amounted to £21,530, and the working expenses to £12,625. Interest on loans absorbed £1,940 and debt redemption £1,948; £3,974 was transferred to the sinking fund and £856 to the reserve fund. Of the 2,264,362 units generated, 64,530 were used on the works, 498,555 were not accounted for, and 1,701,277 were sold, including supply by meter 1,498,028, supply by contract 161,885, and public lighting 41,364. The maximum demand was 920 kw.

Ireland.—Water Power.—The B. of T. has appointed the following gentlemen to be a Sub-Committee of the Water-Power Resources Committee to inquire into and report upon the subject, so far as it affects Ireland:—Sir J. P. Griffith (chairman), Dr. J. F. Cowley (vice-chairman), Mr. T. M. Batchen, Mr. G. Fletcher, Mr. L. J. Kettle, the Earl of Leitrim, and Mr. J. C. White. The secretary to the Sub-Committee is Prof. H. H. Jefcott.

Leigh.—Price Increase.—The Electricity Committee has given notice that the charges for electricity will, from January 1st, be advanced by 10 per cent., making an increase of 35 per cent. during the past two years.

Lighting Restrictions.—The B. of T. has announced that, subject to the rations of gas and electricity not being exceeded, from the 9th inst. and until further notice any number of lights may be used for shop-window lighting; the Advertisements Lights Order remains in force.

London.—Islington.—The B.C. Lighting Committee has reported that in 1917 the electrical engineer estimated the cost of a new turbine, boilers, and other plant at £53,000. Owing to the delay in securing sanction to the loan and in obtaining satisfactory tenders, the cost will now be £125,000.

Stepney.—The L.C.C. Finance Committee has recommended that the proposed loan of £12,000 by the B.C. for the provision of a temporary sub-station and mains be sanctioned.

Woolwich.—In recommending sanction to a loan of £15,000 by the B.C. for extensions at the electricity works, the L.C.C. Finance Committee reports that the original estimate for the extensions at the Globe Lane station was £77,000, while the expenditure up to date amounts to £132,871, and it is estimated that a further £9,885 will be required to complete the work. The B.C. states that during the past four years the plant has been dangerously overloaded, and many items not included in the original estimate have been installed to stabilise the supply. The financial results of the undertaking had been unfavourable up to recent years, but owing to the war-time demand for electricity, the accounts for 1917-18 show a net surplus of £5,701. In view of the cessation of hostilities, the Finance Committee recommends the B.C. to take a careful review of the position of the undertaking.

Loughborough.—Proposed Loan.—The T.C. has decided to apply to the L.G.B. for sanction to a loan of £5,000 for a new boiler at the electricity works, and £2,760 to cover excess expenditure on amounts already sanctioned.

Maidstone.—Price Increase.—The T.C. has decided to increase the price of electricity by a further 5 per cent. as from January 1st.

Rawdon.—Proposed Street Lighting.—The Electrical Distribution of Yorkshire and the U.D.C. are to confer upon the question of lighting the streets with electricity.

South Shields.—Proposed Extensions.—The Special Sub-Committee appointed to deal with the application to the director of E.P. Supply for certificates for further plant has recommended that application be made to the L.G.B. for sanction to a loan of £7,500 for a new boiler and accessories, or, if two boilers are required, for £12,000. A copy of the recommendation is to be sent to the Electric Services Committee, the Ministry of Munitions, and the Board of Trade, with a request for an opportunity for the Council to place its views before these departments before any further action is taken.

The Sub-Committee reported that, at a conference, the Director of E.P. Supply was informed that the Council declined to fall in with his suggestion to supplement its supply by taking energy from the County of Durham E.P.S. Co. As a result, the Director agreed to the Council obtaining one boiler and economiser, and promised to further consider the application for a second boiler. The condition that the Council should obtain energy from the company was withdrawn, but permission to install additional generating plant was refused.

At an interview with the representative of the Controller of Merchant Shipbuilding (Lord Pirrie), a deputation from the Council stated that it was at present in a position to supply the requirements of the shipyards and to fulfil obligations and meet the future increased demand if it was permitted to extend its generating plant. It was pointed out that the plant could be installed in the Council's station as quickly as plant for adapting the supply from the company could be obtained, and that there was no advantage to be gained on the ground of cost.

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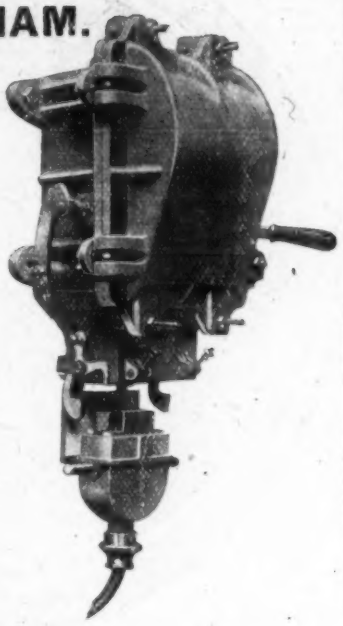

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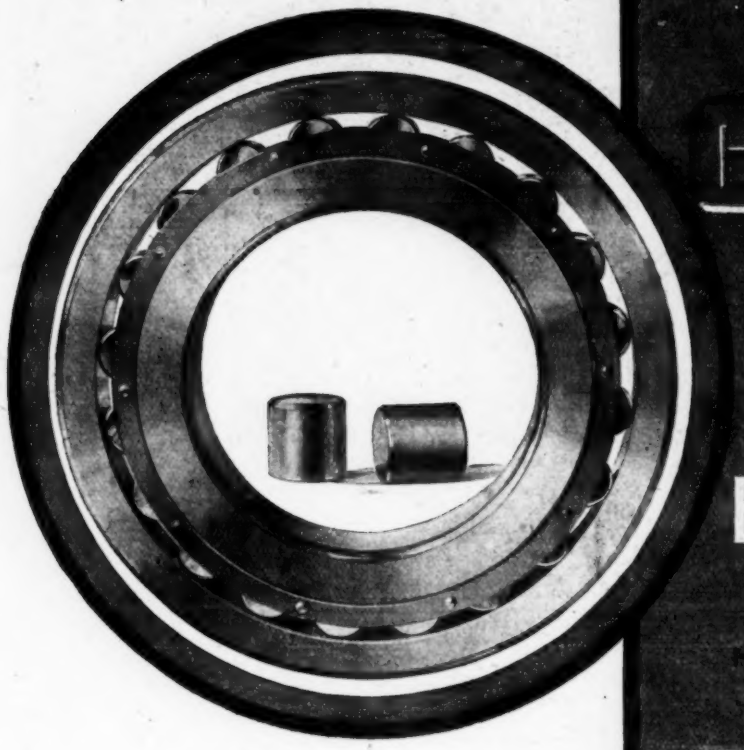

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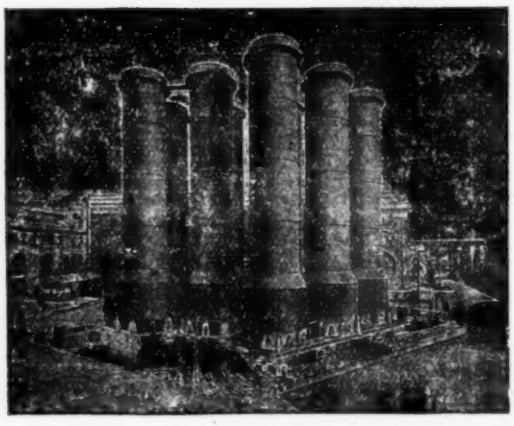

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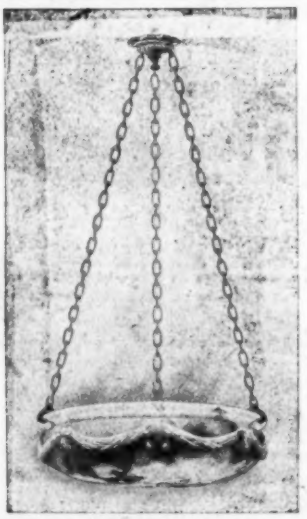

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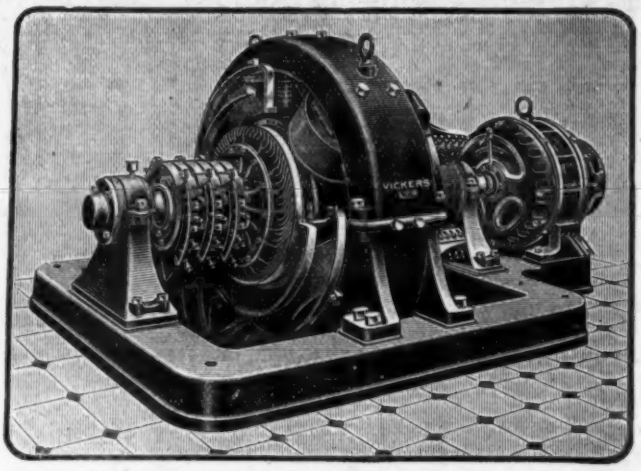

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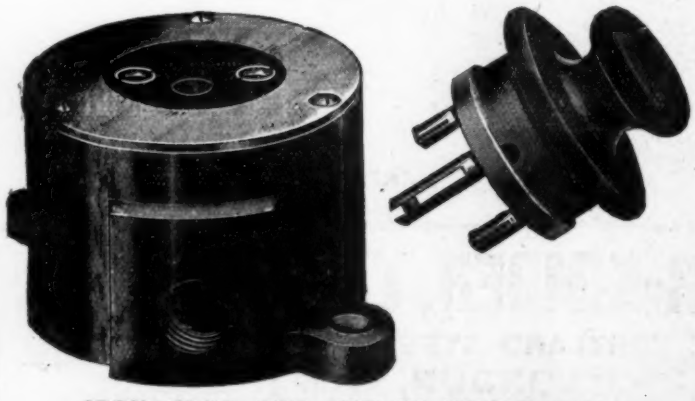

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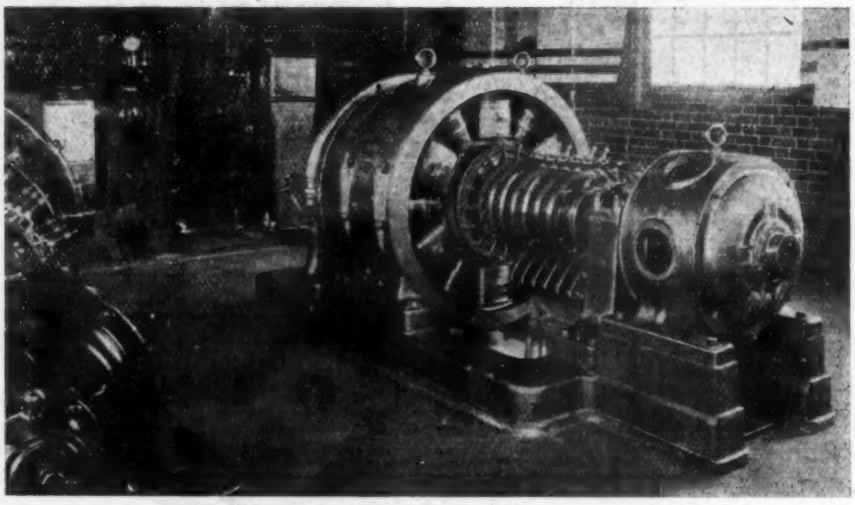

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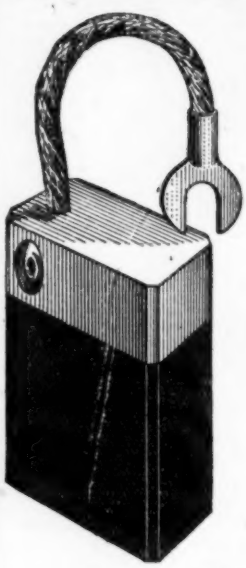

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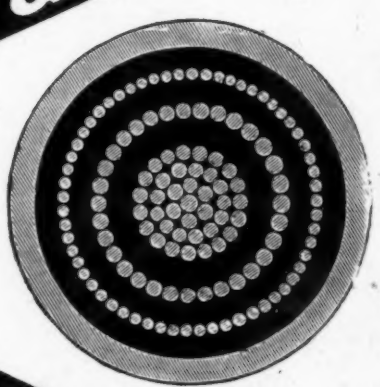

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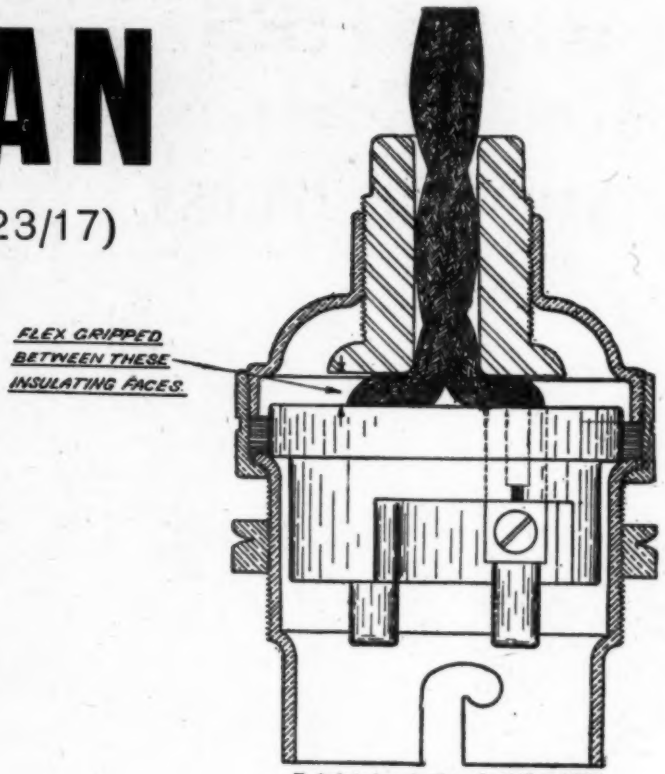

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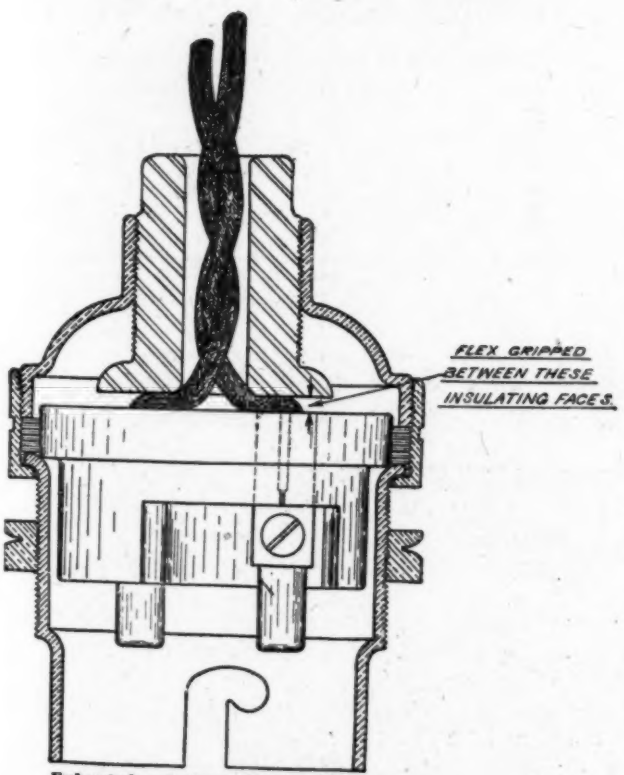

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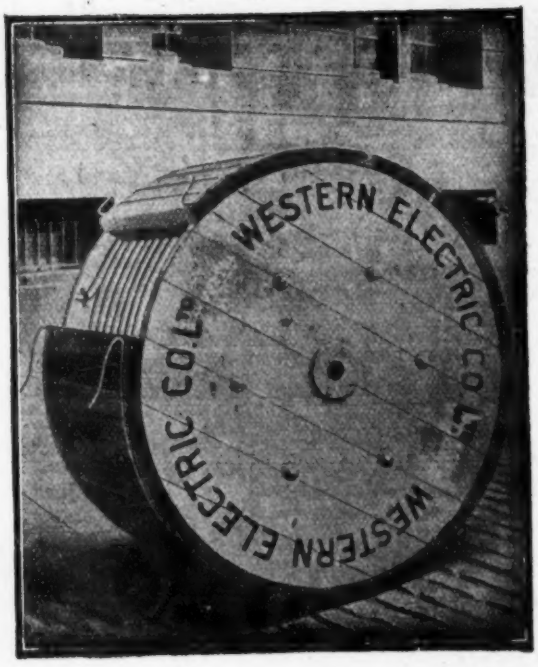

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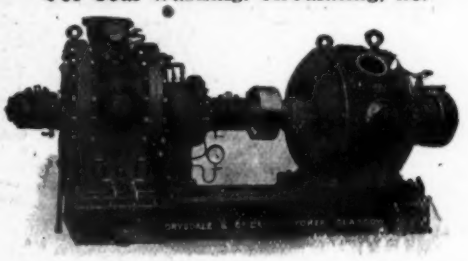

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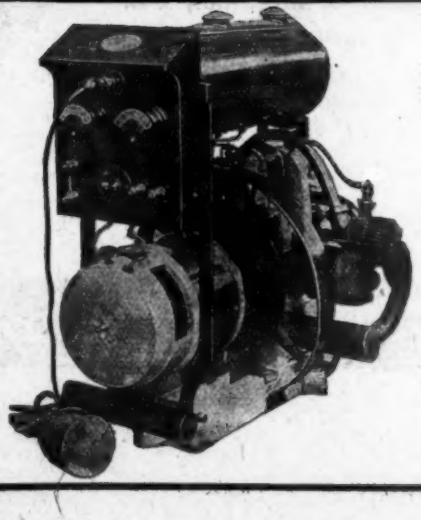

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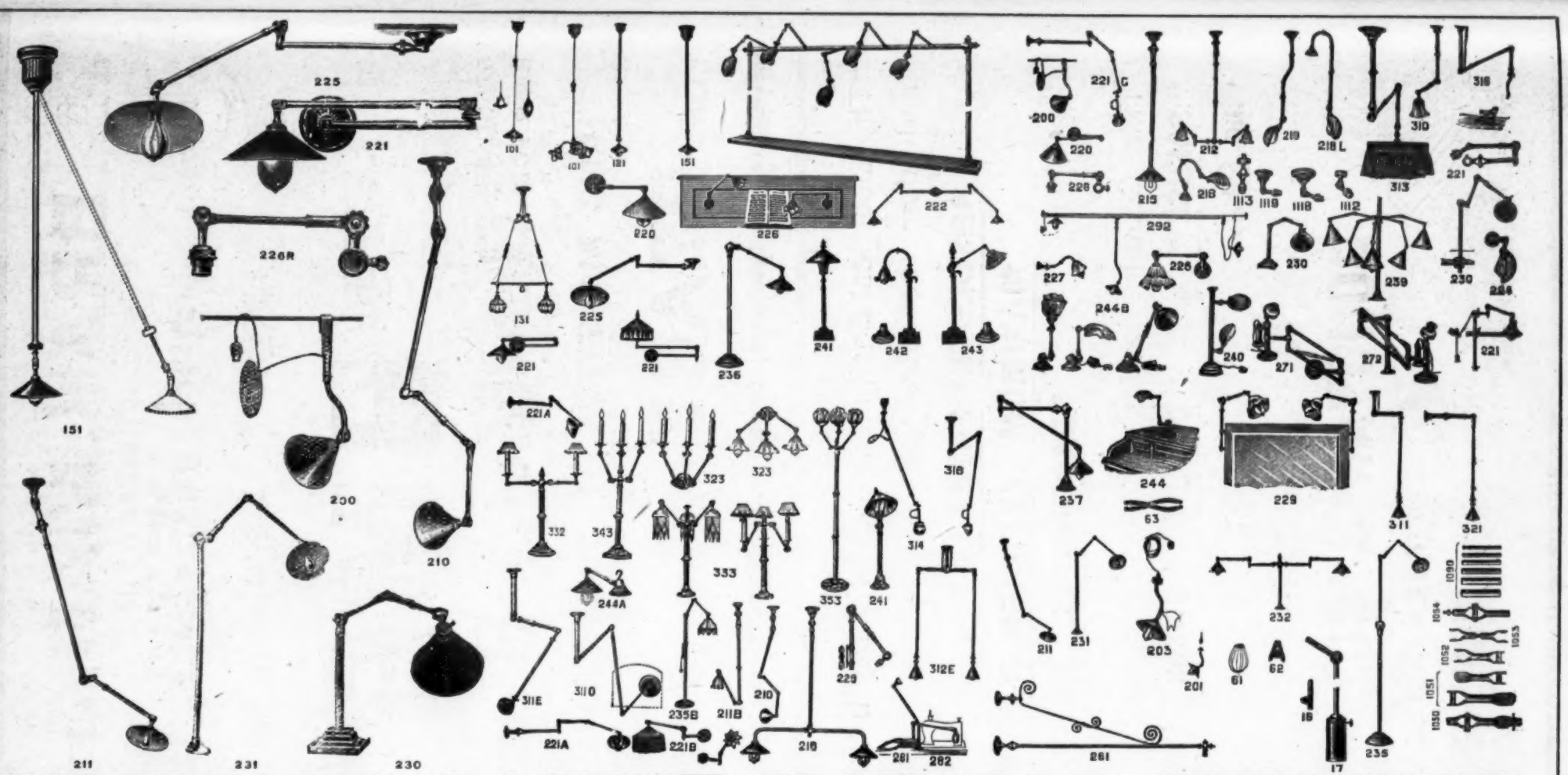

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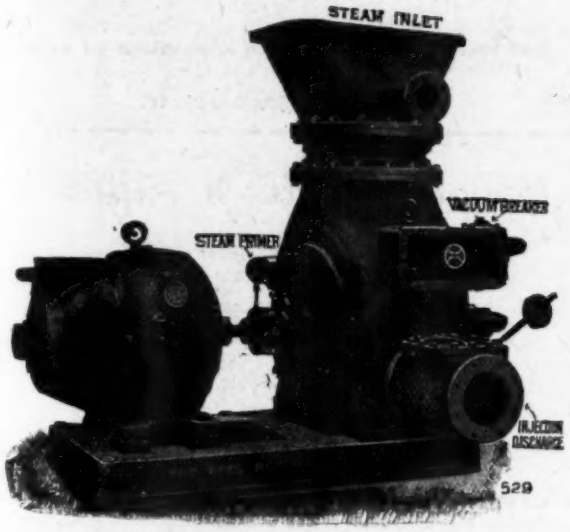

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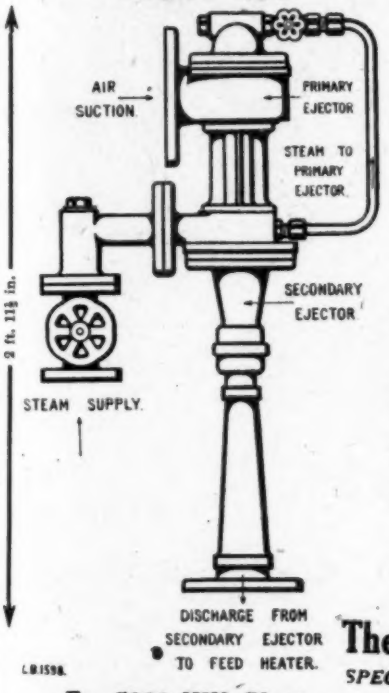

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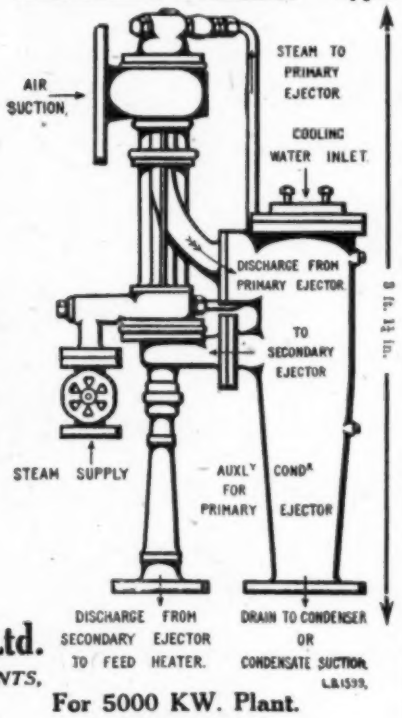

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10*th December*, 1918. 3567

(*Continued on next page.*)

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ARMATURE Winders wanted. Must be first-class men, accustomed to A.C. and D.C. repairs. Good wages.—Apply, LABOUR OFFICE, Ebbw Vale Works, Ebbw Vale, Mon. 3610

ASSISTANT Electrical Estimator, young, wanted in London district, on complete plant layouts, switchgear and transmission line schemes.—Apply, stating age and full particulars of experience, &c., to 3573, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Engineer wanted for Diesel engine station: preference given to a good all-round man with Diesel, wiring and mains experience: permanent post.—Apply, stating wages expected, to H. G. WRIGHT, Electricity Works, Saltburn-on-Sea. 3589

ASSISTANT required with experience in tendering for machines and control gear. Midlands district.—State experience and salary required to 3575, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Shop Foreman wanted by London electrical switchgear manufacturers.—Apply, stating age, experience, wages required, to 6360, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

ASSISTANT Works Manager wanted for works situated in the Midlands, manufacturing light electrical apparatus. To take charge of progress, shop orders, shop clerks, stock rooms, &c. Live man of good education, used to handling staff.—State particulars of education, age, experience and salary required, to 3519, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BATTERY Fitter required to take charge of Tudor and E.P.S. batteries, North London district. Wages 10½d. per hour, plus bonuses, and probable permanency to suitable man.—3542, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BATTERY Inspector.—A man having experience with accumulators and some electrical knowledge is required as Outdoor Inspector for vehicle batteries in the London district. A salary of £2 10s. to £3 10s. per week, according to experience, will be paid, with outdoor expenses up to 10s. per day. No person already on Government work will be engaged.—3374, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BOILER-House Fitter, able to do all repairs to B. and W. chain grate boilers; 53 hours per week; wages 65s. Constant steady job.—3609, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CAPABLE and energetic young Electrical Engineer as Assistant wanted in technical office of London firm, manufacturing D.C. motor control gear. Must be conversant with motor control gear, and able to do correspondence.—Apply, stating age, experience and salary required, to the ELECTRICAL APPARATUS CO., LTD., Vauxhall Works, South Lambeth Road, London, S.W. 8. 6343

CHARGE Engineer required at once for 3000-KW. power plant in steel works: must be fully conversant with steam turbines, alternators, water-tube boilers, able to carry out running repairs and control staff.—Applications, with copies of testimonials, stating experience, age, salary required and when free, to LAKE & ELLIOT, Albion Works, Braintree. 6388

CHARGE-Hand (male or female), capable of taking entire charge of small accessory assembly. Must be thoroughly experienced.—Write in first instance, stating age, experience and wages required, to SUN ELECTRICAL CO., LTD., 57/59, Neal Street, W.C. 2. 3594

CHIEF Draughtsman required for transformer work by large engineering firm in the Midlands. Permanency for suitable man.—Apply, stating age, salary required and experience, to 3572, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN, first-class, small machinery, electrical. Top salary qualified man. Chance young trained engineer.—6323, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN for electrical and scientific instruments. Electro-technical training and some experience in design advantageous.—PAUL ELECTRICAL LABORATORY, Fortis Green Road, Finchley, N. 2. 6140

DRAUGHTSMAN required in central station; mechanical training desirable; wages £2 15s., plus bonus.—Apply in writing, giving particulars, ELECTRICAL ENGINEER, 50, Eden Grove, Holloway, N. 7. 3453

DRAUGHTSMAN required; must have experience small motor design; N. district. State age, salary and experience.—3434, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN Section Leader, well versed in design of H.T. switchgear, wanted by North Country Firm.—3408, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN wanted at once for Midlands; experienced man, for overhead high-tension transmission work. Must be thoroughly acquainted with latest practice.—Apply, stating full experience, age and salary required, to 3596, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN.—Wanted, Draughtsman conversant with mechanical design of continuous and alternating current electrical machinery.—State age, salary required, &c., CHIEF DRAUGHTSMAN, Bruce Peebles & Co., Ltd., Edinburgh. 3559

DRAUGHTSMAN wanted for industrial and colliery engineering equipments.—State age, experience and salary, 3528, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMEN and Improvers wanted for high and low-pressure switchboards, Manchester district.—State age, experience and wages required, 3525, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMEN required for transformer work by large engineering firm in the Midlands. Permanency to suitable men.—Apply, stating age, wages required and experience, to 3571, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(*Continued on next page.*)

SITUATIONS VACANT.—*Continued.*

DRAUGHTSMEN.—Permanent progressive positions offered to capable men with knowledge of cable accessories, junction boxes, fuseboards, street pillars, &c.; works near Liverpool.—State age, experience and salary required, 3376, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMEN, required for large electrical works in Midlands, preferably with practical and technical experience on instrument work, positions permanent and progressive.—Apply, stating age, full details of experience and salary required, to 3508, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMEN (several), at once, for telephone and electrical apparatus drawings; also Tool Draughtsmen; good permanent position for competent men.—Please state age, experience and salary required, to Box 208, Sells, Ltd., 168, Fleet Street, E.C. 4. 6387

DRAUGHTSMEN, wanted immediately, two or three experienced mechanical Draughtsmen, salary according to ability, plus war bonuses.—Apply JOHNSON & PHILLIPS, LTD., Charlton, S.E. 7. 3523

DRAUGHTSMEN.—Wanted, several good men for works in London district, with Switchgear experience.—Reply, giving full particulars, stating age and salary required, to 3561, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRIVER Switchboard Attendant wanted for small D.C. three-wire station, with knowledge of batteries. Must have held a similar position. Wages 11½d. per hour, plus 12½ %. Also Relief Stoker, must be used to B. and W. boilers, chain grate stokers, &c.; wages 10½d. per hour, plus 12½ %.—Apply, with particulars, to KIDDERMINSTER AND DISTRICT ELECTRIC LIGHTING AND TRACTION CO. 6330

DYNAMO Testers, with previous experience, wanted for A.C. and D.C. machines for heavy output. Manchester district.—State age, experience and salary required, to 3490, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Estimator wanted, thoroughly reliable man, thoroughly conversant with A.C. and D.C. switchgear.—Apply WHIPP & BOURNE, LTD., Castleton, near Manchester. 3419

ELECTRICAL (Scientific) Instruments.—Skilled Test-room Assistants required; preferably technically trained men with shop experience on high grade instruments.—PAUL ELECTRICAL LABORATORY, Fortis Green Road, Finchley, N. 2. 6141

ELECTRICAL Wiremen, several, wanted at once for London work. Used to all classes of lighting, power and bell work.—3593, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN wanted for maintenance of motors (D.C.), lighting, and telephones in large clothing factory.—Apply by letter, stating wages and experience, to HART & LEVY, LTD., Leicester. 6381

ELECTRICIANS wanted, permanent work at union rates to suitable men.—VERNON HILL, Broadstairs, Kent. 6190

ENGINE Driver for Suction Gas Engines, one used to vertical engines preferred; 56 hours at 1s. 2d. per hour. Two shifts.—ENGINEER, Electric Supply, Ammanford, Carmarthenshire. 3327

ENGINE Driver wanted. Used to reciprocating engines and turbines.—Apply, with full particulars and experience, age, and enclose copies of testimonials, to THE NORTHAMPTON ELECTRIC LIGHT & POWER CO., LTD., 25, Bridge Street, Northampton. 3537

ESTIMATING Engineer required for A.C. motor and switch work.—State full particulars of experience, age, salary, to 3608, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ESTIMATOR required at once. Must be thoroughly capable. Preference to one accustomed to electrical engineers' office and factory. Permanent progressive appointment for suitable man.—Write, stating age, experience and salary required, to Box 201, Sells, Ltd., 168, Fleet Street, E.C. 4. 6363

EXPERIENCED Foreman or Forewoman required to take charge of flashing and mounting department, carbon filaments.—9728, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

EXPERIENCED Wiremen and Mates wanted.—ENGINEERING WORKS, LTD., 7 & 8, Great Winchester Street, E.C. 3520

FITTER-Driver wanted in a small electric supply station, experienced in running and overhauling Diesel and suction gas engines.—State references, experience and wages, to 6345, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FITTERS and Turners wanted. Used to engine and general repair work.—Apply, with full particulars and experience, age, and enclose copies of testimonials, to THE NORTHAMPTON ELECTRIC LIGHT & POWER CO., LTD., 25, Bridge Street, Northampton. 3536

INSTRUMENTS.—Working Charge Hand or Foreman for commercial ammeters, voltmeters, &c. Good prospects for right man in this new department.—Apply, stating age, experience and wages required, 6391, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

JOINTER-Wireman required for high and low-tension cables. Able to do plumbing. One with experience of car-wiring preferred. Wages £3 15s. for 56-hour week, inclusive of all bonuses to date.—Applications, with experience, when at liberty, and enclosing copies of testimonials, to RHONDDA TRAMWAYS CO., LTD., Porth, Glam. 6375

LARGE dynamo firm, not in Manchester or the Midlands, requires immediately two Assistant Electrical Designers, one familiar with alternate current machines from 100/600 H.P., and the other familiar with direct current machines over the same range. No person without experience over the above range machines need apply.—State in confidence, experience and salary required, to 3436, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

LARGE firm of paper, bitumen and rubber cable manufacturers require some first-class Engineer Salesmen to operate in the British Isles, having headquarters at Newcastle, Glasgow, Portsmouth and Cardiff respectively.—Apply, in first instance, to 3540, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

LEADING firm of contractors require immediately capable man with experience in electric accessories. Must have good knowledge of markets, and be responsible for maintaining stocks and issuing quotations; experience in estimating for wiring contracts an advantage.—State age, experience and salary, 3527, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

LIFT Repair and Maintenance.—Wanted, immediately in London capable Electrical Engineers accustomed to this work.—3554, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MANAGER Required for Dry Battery Factory; must be expert in the manufacture of all kinds of dry batteries, good organiser and capable of dealing with large output.—Apply, stating salary required and experience, 3576, ELECTRICAL REVIEW, 4, Ludgate Hill London.

MANAGER wanted, competent, good organiser, disciplinarian, interviewer and salesman; experience in factory electrical accessories an advantage.—Write, stating experience, age and salary required, to 6275, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MECHANIC, useful, wanted for few months, with knowledge of mineral water electrical machinery.—S. WRIGHT & CO., Walkern, Herts. 6361

MECHANICIANS wanted to assemble delicate moving-coil instruments.—Apply, stating full particulars of previous experience, to the CAMBRIDGE SCIENTIFIC INSTRUMENT CO., LTD., Cambridge. 3597

METER Reader accustomed to slots wanted at once.—Apply, stating age, with full particulars and copies of two recent references, to CHIEF ENGINEER, Electricity Works, Watford. 3598

PLUMBER-Jointer required by Electric Supply Undertaking in the Midlands. Good E.H.T. jointer. Permanency.—Apply, stating age, experience and wages, to 3460, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PRACTICAL Man wanted to repair Excello Flame Arc Lamps.—Apply by letter, stating age, nationality, wages required.—HOWARD ELECTRICAL CO., LTD., Bathley Street, Nottingham. 6357

PUBLIC Lighting Attendant wanted immediately.—Apply, stating age and full particulars, together with copies of two recent references, to CHIEF ENGINEER, Electrical Works, Watford. 3599

REQUIRED, capable man, with good experience of all classes of M.F. and half-watt lamps, to take charge of Lamp Sales Department of Wholesale London House. None but those accustomed to handling large sales need apply.—Applications, strictly confidential, stating experience and wages required, to 3603, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

REQUIRED, for London district, Traveller, of good address and experience, to represent important London wholesale house whose range of supplies and specialities cover everything electrical. Remuneration, salary and commission. Applications will be treated in strict confidence.—Write, stating full particulars, to 3604, ELECTRICAL REVIEW, 4, Ludgate Hill, London

REQUIRED, Telephone Faultsmen and Installers with intercom. experience. Good wages for good men. Permanency.—Apply between 9 and 10 any morning to I. T. C., LTD., 147/149, Great Portland Street, W., 1. 3397

REQUIRED, Traveller, with experience, for London district, for wholesale house of electrical accessories and fittings.—3415, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SHIFT Engineer required at large London Electric Power Station (certified by Government) on running of mechanical side of plant. Must be skilled mechanic with experience of large turbine units. Wages, including war advances, from £4 15s. to £5 5s. per week.—Reply, stating age and particulars of experience, to 6406, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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SITUATIONS VACANT.—*Continued.*

SHIFT Engineer wanted, 3-wire D.C. station, with battery, Babcock & Wilcox boilers and turbine experience preferred.—Apply, stating qualifications, age and wages required, to MANAGING ENGINEER, Banbury & District Electric Supply Co., Ltd., Banbury. 3579

SWITCHBOARD Attendant wanted for A.C. supply station, London district. Preference given to those with sound technical training and practice combined with steam experience. Wages £3 + 23s. 6d. + 12½% per week.—Apply, with full particulars, to RESIDENT ENGINEER, North Met. E. P. S. Co., Brimsdown, N. 6380

SWITCHBOARD Attendant wanted with experience in A.C., H.T. and D.C. supply.—Reply, with copies of testimonials, stating age and wages required, also experience, to the SHEERNESS AND DISTRICT ELECTRIC POWER & TRACTION CO., LTD. 3368

SWITCHGEAR Draughtsmen required by MESSRS. JOHNSON AND PHILLIPS, Charlton, London; only thoroughly experienced men required. When applying please give full particulars, age and salary expected. 3526

SWITCHMAN wanted, accustomed to paralleling large E.H.T. 3-phase sets.—State age, experience and salary required, to 3487, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TELEPHONE Engineer required having good technical education and experience of telephone exchange equipments: good prospects and salary for qualified man.—State full particulars to 3577, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TEST Room Assistant wanted for testing Magazine Flame Arc Lamps and Searchlights.—Apply, stating age, wages, experience, &c., to JOHNSON & PHILLIPS, LTD., Charlton, London, S.E. 7. 3592

TEST-Room Assistants wanted at once for high-class Instrument work. West of London. Competent men only.—Apply, stating age, salary, experience, 3607, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, a Designer for small Motors, &c., for electrical engineers' works near London.—Full particulars as to experience and salary required, to 3574, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, an experienced Engineer, for estimating and designing country house installations (electric, gas); knowledge of fittings design, and experience in showroom preferred.—State experience, age, and salary expected, 3411, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED by Electrical Contractors, an Engineer with experience in the electrical equipment of mills and factories to work in Midland district. Staff appointment; accustomed to interviewing clients.—Apply, stating salary required, to 6374, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED by railway company, Shift Engineer, with some H.T. experience. Small central station, London. Salary, including all bonus awards, £3 10s. week.—Experience and when disengaged, to 3543, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Charge Engineer, with experience with turbines, water tube boilers, and E.H.T. 3-phase. Starting salary £3 10s. per week.—Apply, giving full particulars and enclosing copies of testimonials, to 3538, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, competent Electrical Engineer to take charge of electrical plant in large engineering factory in the Midlands.—Write, giving fullest particulars of experience and qualifications, salary required, &c., to Box 985, Willings, 125, Strand, W.C. 2. 3424

WANTED Electrical and Mechanical Engineer, energetic expert and reliable, qualified by practical, personal experience especially, to take charge of department installing electric light plant, gas and oil engines, turbines, pumps, dynamos, accumulators, electrical heating and cooking appliances for modern residences, hotels, convents, institutions and estates. To work hand in hand with sanitary, hydraulic and heating engineers in other departments in an old-established concern of contractors and merchants in Dublin, Ireland. To interview clients, travelling occasionally to inspect sites and residences, prepare estimates, obtain orders, and supervise work in progress. Apply in own handwriting, giving references, age, salary required, and full particulars. Replies will only be sent to apparently suitable candidates.—Box 950, care of Easons Advertising Agency, Dublin. 3580

WANTED, Electrical Fitter and Wireman.—Apply, ABRAM LYLE & SONS, LTD., Plaistow Wharf, Victoria Docks, E. 3595

WANTED, Electrical Fitter, Wireman, and Winder.—Apply, stating full particulars of experience, wages required, &c., to WILLIAM ASQUITH, LTD., Halifax. 3568

WANTED, experienced Driver, accustomed to steam turbines and vertical engines. Lancashire coast town. Hours 56 per week.—Apply, stating experience, age, &c., to 3454, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

WANTED, first-class Armature Winders for London repair shop. Best rates paid.—3366, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for Insurance Company, estimating or Costs Clerk. Good experience of electrical repair work essential.—3555, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for Power Company, Engineer-in-Charge, with E.H.T. three-phase experience and good mechanical training. Wages £3 10s. to £4 per week, inclusive of all bonuses.—Apply, giving all particulars, to 3590, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for Sales Counter of leading Wholesale Supply House in London, first-class Salesman with intimate knowledge of accessories and electrical apparatus generally. Applicants' communications treated in strictest confidence.—Write, stating experience and wages required, to 3602, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for steel works and blast furnace plant in Monmouthshire, one Armature Winder accustomed to A.C. and D.C. repairs; also two Foremen Electricians to take 12 hours' shift, night shift and day shift, week about. Only men of experience need apply.—3428, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Gentleman used to catalogue compilation and minor advertising work, by one of the leading firms in the electrical trade.—Write stating age, qualifications and experience in similar work, together with commencing salary required, to 3493, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED immediately, several first-class Armature Winders; must be used to heavy-class work.—Apply BURDETTE AND CO., LTD., 7, Pocock Street, Blackfriars, S.E. 3433

WANTED, Improver in H.T.A.C.M.S., state age, wage, and experience. Experience in wiring necessary.—F. R. WINDSOR, Generating Station, Monmouth. 3488

WANTED, several good Wiremen, factory work, 30 miles from London.—3578, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Shift Engineer for 500-KW. Traction and Lighting station. Must be a capable and energetic man with good all-round mechanical experience of steam plant, also battery maintenance. Situation East Coast. Station buildings large and well ventilated.—Apply, stating wages required, also age, to 3515, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMAN, good man, used to factory work.—RUSSELL, Loates Lane, Watford. 6224

WIREMAN (lighting, power); also Smart Improvers.—LINDOW, 87, Parkhurst Road, Holloway. 6395

WIREMAN'S Mate wanted, North London district. Wages 8d. per hour, plus bonuses.—3541, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMEN wanted. Permanency. Wages on basis of £3 6s. 3d. per 50-hour week, including all bonuses.—Reply, stating age and experience, to NORTHAMPTON ELECTRIC LIGHT & POWER CO., LTD., 25, Bridge Street, Northampton. 3606

WORKS Manager or Works Foreman wanted for switchgear work, must be strict disciplinarian and used to competitive production.—Apply, giving fullest particulars of experience and salary required to 6420, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

YOUNG men required, with some electrical experience, to train as Assistants at electric vehicle battery depôt in London, and also as Assistant inspectors. Wages to commence £2 10s. per week.—Apply, stating age and experience, to 3416, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS WANTED.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

A BREWER'S Chief Electrical and Mechanical Engineer desires change.—6240, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A CONSTRUCTIONAL Supervising Electrical Engineer desires to get into communication with firms desiring his services now or in the near future. Ten years' experience of cable laying distribution work, ducts, solid, direct, &c., to 25,000 volts. Well up in power distribution for mills, steel works, &c., overhead transmission line erection, steel lattice poles, concrete, pine, &c., to 10,000 volts. Record work done South America, Portugal, France. Five years for English company. Conversant Spanish, Portuguese, French, Busque. Used handling large contracts, men and money. Will go anywhere on five years' agreement.—6367, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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SITUATIONS WANTED.—*Continued.*

A TELEPHONE Engineer (age 39), with 25 years' practical and technical experience of switchboards, inter-communications, alarms and relay work, all installation systems, inclusive automatics and dictographs, good circuit designer, and quick faultsman; seeks change as department foreman, or travelling representative, to advise, estimate or rectify installations, distance no object: Substantial references. State best terms.—6382, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A THOROUGHLY capable electrical Engineer (33), disengaged, 18 years' practical experience, conversant with gas, oil supply plants, erection, contracting, good references, reliable, hard working, successful station manager.—6372, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ACCESSORIES, cable, conduit, motors. Advertiser (38) seeks progressive berth, 14 years' experience charge, sales, order, dispatch, practical and technical experience, nominal salary.—6332, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, formerly managing engineer eminent London contractors, recently own business, 25 years' wide varied practical experience, seeks responsible position.—6409, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER (military officer) seeks to get into touch with concerns desiring to fill positions of superior responsibility. 15 years' experience covering factory planning and problems, railway signals, lighting and power, millwrighting, refrigeration, cranes, lifts and hoisting appliances, maintenance. Immediate interview.—6325, ELECTRICAL REVIEW, 4, LudgateHill, London.

ADVERTISER (25) requires responsible and progressive position. Good general electrical experience. Speciality wireless apparatus and plant. Capable organiser; accustomed to control of men and women.—6317, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER (29) desires post; late Assistant Electrical Engineer H.M. Factory; 11 years' experience power house, test room, experimental, speciality instruments and small apparatus.—6144, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AN Engineer, college diploma, practical training, 14 years' experience, electrical and mechanical, requires responsible post; contract work or maintenance preferred.—6301, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AN Engineer Lieutenant, R.N. (temporary), desires post as Chief Assistant in Supply undertaking. Responsible experience with modern plant of all types and sizes. Age 27. £250.—6364, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARC Lamp Fitter; preference for corporations; thirteen years' experience on all types of flames and open arcs.—6234, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AS Works Chief Electrician, or Assistant to Contractor. Thorough experience. Erection, upkeep, supervision, interviewing, knowledge estimating. Complete installations, factory, town and country house. Good references.—6282, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSEMBLY or Test Shop Assistant. Officer (21), 2½ years in charge wireless station, desires post with firm manufacturing wireless apparatus or electrical instruments. First-class certificate, radiotelegraphy. I.C.S. student; energetic, ambitious, trustworthy. Released one month after appointment. In or near London preferred.—6179, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Engineer (41), 24 years' experience large power and lighting installations, central stations, Diesel engines, telephone and lift installations, testing, workshop, office, commercial experience, control of men, initiative and business ability. 6410, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Shift Engineer (24), officer (ex service), energetic, trustworthy, experienced in A.C. and D.C. machines, fitting and draughtsmanship; held responsible position in three-phase, E.H.T. to D.C. sub-station, desires early engagement in similar position; Lancashire preferred.—6416, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BUYER of one of the largest houses in the country, desires re-engagement, at liberty shortly, engineering, building, and other classes of material.—6336, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CHARGE Engineer, good mechanical experience, A.C. and D.C., &c., requires post.—6213, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMMERCIAL Engineer, at present with leading Scotch firm, wishes responsible position. Organising ability combined with extensive practical and commercial experience in the application of electricity to industrial problems. Technical training; good estimator, correspondent and interviewer. Interview Glasgow.—6258, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMMERCIAL Engineer, with over twenty years' practical and commercial experience, supervision, estimating, preparation of catalogues, general publicity and travelling, seeks opening with good firm manufacturing electric heaters, power applications or switchgear, or as consumers' engineer.—6362, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS WANTED.—*Continued.*

CONSULTING Engineers open for further work.—6237, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DESIGNER (electrical apparatus) shortly at liberty.—6393, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRIC Light, power, telephones, installations, or repairs. Used modern factory equipment, take charge or otherwise.—6294, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer (aged 43), having had over 20 years' experience in the manufacture, lay-out, erection and maintenance of power plants, accustomed to control large number of men, is now open for engagement.—6308, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer desires appointment; 12 years' experience in oil and gas-driven plant, power and lighting installations and maintenance; commercial experience; late Admiralty overseer; London district or Southern counties preferred.—6302, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer (experienced) desires position as estimator, buyer, or technical assistant.—6394, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer, experienced (46), seeks situation. Country charge of plant, steam, gas, oil, Diesel engines. Late of a duke's large up-to-date plant. Repairs, alterations, improvements.—6192, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer, fully trained (with special knowledge of Diesel plants, used to handling men and all classes of electrical and mechanical machinery), seeks responsible post.—6358, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer, H.T., three-phase, D.C. and turbine experience. Held responsible position in large power house. At present engaged at munition works, will shortly be at liberty to take another post.—6212, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Contractor's Foreman desires change; over 20 years' practical experience factory and private installations and maintenance A.C. and D.C.; good references.—6161, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Contractors' Foreman (34) requires berth. Good experience installation and maintenance of light and power. A.C. and D.C. South preferred.—6418, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, age 23, nine years' shop and drawing office experience on A.C. and D.C. switchgear, desires position as Assistant in Sales or Estimating Office. Highest references; state salary.—6407, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, aged 30, workshop, technical and commercial training; salesman; experienced in the design and invention of instruments; knowledge of switchgear, machines and W/T. Three years' commissioned flying service, electrical branch. Desires correspondence with a view to appointment.—Address S.W., Grosvenor House, Grosvenor Road, Weymouth. 6370

ELECTRICAL Engineer desires responsible appointment in connection with electric lighting and power distribution, layout of installation, charge of power house, inspection of plant, &c., control of staff; economical working.—6261, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, fully trained and experienced, seeks position in commercial dept. of electrical firm or electrical dept. of mechanical engineering firm. Willing to go abroad.—6252, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, shortly be demobilised, 15 years' chief electrical engineer to large town. Previous consulting and contracting engineer. Good experience of power company's supply systems, Government departments.—6251, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, university graduate, M.I.E.E., 23 years' wide and varied practical and commercial experience generation, distribution, industrial application and use electricity, desires responsible position with progressive manufacturer, contractor or consultant.—6233, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, 20 years' experience; good all-round erecting or maintenance of factory or institute. Good references.—F., 18, Penton Place, King's Cross Road. 6403

ELECTRICAL Engineer (28) having been through workshops, now engaged technical department leading firm, seeks position where this experience useful.—Particulars, 6351, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(*Continued on next page.*)

SITUATIONS WANTED.—*Continued.*

ELECTRICAL Engineer (30), four years' college, three years' apprenticeship, power house and test, drawing office, switchgear design. Prefer technical assistant to large undertaking or manager-designer of general electrical manufacturing shop.—6255, ELECTRICAL REVIEW 4, Ludgate Hill, London.

ELECTRICAL Engineer (31) desires engagement; 10 years' experience, including production, test and technical representative.—6246, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (34) desires appointment; 15 years' wide practical and technical experience contracting, commercial, supervision transmission lines and cables, control of labour. £350 per annum.—6260, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (45), 20 years' practical experience, steam, petrol, oil and suction gas power plants, accumulators, mains, installations, telephones, estimating and interviewing, at present charge five contracts (country), all obtained on own initiative, desires appointment where thorough business ability and zeal is appreciated.—6321, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN (age 35) wants berth. Thoroughly experienced, dynamos, motors, lighting, accumulators. Conversant with steam engines. Charge of plant preferred.—BROWN, 601, Romford Road, Forest Gate. 6397

ELECTRICIAN, maintenance, lighting and power; used to busy machine plant; good all-round hand.—6157, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, practical mechanic, disengaged, requires charge country house electrical plant, own repairs, good references, 6 years last job.—M. G., 2, Alexandra Road, Dagenham. 6371

ELECTRICIAN requires permanancy, used to erection and maintenance of factory and works plant.—6346, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN (28), seeks situation, London district; 14 years' experience A.C. and D.C. Maintenance or contracting.—6379, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN-Wireman desires permanency, installations' maintenance, or upkeep of plant, &c.—GLANVILL, 21, Cloudesley Street, Islington, N. 6399

ELECTRICIAN-Wireman, experienced, good reliable hand, late charge.—W., 113, Albert Street, N.W. 1. 6411

ELECTRICIANS (two), good, all branches.—G., 133, Lupus Street, S.W. 1. 6396

ENGINEER, electrical and mechanical, practical and technical experience, good organiser and controller of labour, possesses initiative, tact and business ability.—35, de Crespigny Park, S.E. 5. 6172

ENGINEER, millwright, thoroughly reliable, been in charge of large works, doing own erecting, own repairs, both electrical and mechanical. Excellent testimonials. Age 36.—POWELL, 70, Standen Road, Wandsworth, S.W. 18. 6383

ENGINEER, with 18 years' experience, requires position as Representative, Lancashire and Yorkshire district preferred, as advertiser is well known there in connection with Electrical Apparatus.—6276, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEER'S Fitter (33), with power station and general mechanical experience, desires appointment abroad. Well educated; used to control of labour.—KEMP, 50, Robertson Road, Bristol. 6398

FOREMAN Assembler, with long and varied experience in electrical industry, seeks situation with large firm of manufacturing electricians. Expert on Switchboard and Controller work. Sound references.—6280, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOREMAN (Instrument Maker), nine years' experience as such, Age 36, active, able to get production.—6131, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

INDIA.—Mechanical and Electrical Engineer, who speaks Hindustani fluently, requires responsible post. Holds first class B.O.T. Experience includes erecting and running plant, A.C. and D.C., D.O., refrigerating.—6236, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MECHANICAL and Electrical Engineer, workshop and drawing office training, 16 years' experience in constructional and maintenance of modern power station, desires change, similar work.—6151, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

R.A.F. Officer (25), with good pre-war experience in electrical engineering, technical, drawing office, testing mains, and power station, desires to correspond with principals with a view to appointment. Interview can be arranged at any time.—6285, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

THREE Outside Erectors seek erection of plants on contract or otherwise, on gas, steam and mining; wide experience both home and abroad.—H. A., 238, Peel Green Road, Patricroft, near Manchester. 6183

SITUATIONS WANTED.—*Continued.*

TO Managers of up-to-date Electric Supply Undertakings.—Capable Staff Engineer wants post. £300.—6283, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TO Managing Directors.—Advertiser, a thorough Commercial Electrical Engineer (technical), with enormous City experience, dealing exclusively with War Office and Admiralty contracts, is open to engagement. Highest credentials, love of work and full of energy, gentlemanly in appearance and manners, fully conversant with business methods A to Z and knows precisely how to interview prospective clients. Army record, commissioned rank; discharged; limbs and brains left intact. Who will utilise to the best advantage?—6266, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMAN, used lighting, arcs, bells, screwed tubes, desires permanency in London factory, where could gain experience motor repairs, maintenance.—6347, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMAN'S Mate wants job, experienced, used screwed tube. H. M., 2, Sewardstone Road, Bethnal Green, E. 2. 6392

WORKS Foreman (or Manager), 20 years' practical experience in A.C. and D.C. motor control gear, switchboard, &c. Accustomed to up-to-date methods of production, tactful and capable organiser. Large Works experience.—6365, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WORKS Manager, with successful career, seeks similar position of trust with progressive company, manufacturing electrical accessories. Good organiser, sound practical, and commercial knowledge; experience in rate-fixing, estimating and control of male and female labour.—6292, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

YOUTH (17), intelligent, seeks situation, Electrical Assistant.—MILLER, 69, Netherwood Road, W. 14. 6402

PARTNERSHIPS.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

ELECTRICAL Engineer desires appointment as Manager or Managing-Director of an electrical engineering and contracting business; long and successful business experience in similar capacity.—6373, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FIRM of electrical engineers about to extend their contracting branch in London, wish to negociate with a gentleman who has an electrical business connection, on a commission or partnership basis. All office staff and expenses will be provided.—3404, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FIRM of Electrical Engineers in London about to extend their contracting branch, wish to negotiate with a gentleman who has an electrical business connection, on a commission or partnership basis. All office staff and expenses will be provided.—3404, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GENTLEMAN (35), with small capital, wishes to correspond with another, with view to opening repair business for small electric motors, apparatus, &c., or an installation contracting business. London or Provinces. At present serving with H.M. Forces.—6281, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for Provinces, practical man as partner in well-established manufacturing and factoring business of electrical and motor accessories. Good opportunity for right man. Capital required from £500 to £800.—6412, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.).
Box Number and ELECTRICAL REVIEW address count as seven words.

A FIRM of Engineers having office in an important chambers in a South Wales seaport town, with extensive connection, would like to Represent Manufacturer of Electrical and Mechanical Specialities.—6356, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, 20 years' experience, wishes to represent Manufacturers of Electrical Accessories, Cables, Glassware, &c., for London and district.—Apply DAVIS, 11, Sun Street, E.C. 2. 3478

ADVERTISER, 20 years' experience, with live connection amongst best-class electrical houses, wishes to take up Agencies for London and district for French and English Electrical Fittings.—Apply DAVIS, 11, Sun Street, E.C. 2. 3472

(Continued on next page.)

AGENCIES.—*Continued.*

ADVERTISER, 22 years' experience, wishes to take up Agencies for Yorkshire, Lancashire and North of England, for Accessories, wires, cables, motors, switchgear, fittings, carbons, conduits, bells, heating and cooking, miners' electric lamps, and engineering supplies.—Particulars, 6189, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES wanted for all classes of Electrical Goods. First-class connections.—3486, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCY for Tyne, Tees and Wear area, for post-war activities. An Electrical Engineer, of 20 years' standing, is prepared to act as Representative of single firm of manufacturers, or would work agencies for C.M.A. firm, generators, motors, transformers, &c., for reputed manufacturers of these articles.—6263, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENT wanted in all large towns for wooden handles, &c., and all classes of turning work in wood and Vegetable Ivory suitable for electrical trades.—JONES, LTD., 13, All Saints' Street, Birmingham. 6419

AGENTS required for all parts of the country to handle goods of a firm manufacturing Resistance Apparatus.—Apply in first case, stating terms and ground covered, to 6191, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENTS wanted for few districts on commission basis for British electric lamps, ordinary type; also miners and motor car bulbs. Very remunerative. Only applicants likely to do large business entertained.—6341, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENTS wanted in the following towns and districts for a well-known firm of Lift and Crane Makers: Aberdeen, Bristol, Plymouth, Cardiff, Hanley, Nottingham, Sheffield, Leeds, Harrogate, Newcastle, Hull, Belfast, Brighton, Portsmouth, Grimsby, Bournemouth, Manchester, Lowestoft, Folkestone, Weymouth, Torquay, Ilfracombe, Basingstoke, Winchester, Margate, Colchester, Ipswich, Bath, Hastings, Derby, Eastbourne, Tunbridge Wells, Reading, Southampton, Bradford, Scarborough; also in Belgium and France.—6274, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AUSTRALIA.—The advertiser, Australian by birth, at present occupying a responsible position as engineering sales manager in this country, is desirous of returning to Australia as representative of some first-class concerns, which are desirous of opening up or extending their business there. He has a thorough knowledge of the country and has extensive business connections. Highest testimonials and references.—Correspondence invited with C. N., c/o J. W. Vickers & Co., Ltd., 5, Nicholas Lane, E.C. 4. 6349

BELGIUM.—Electrical engineer (Belgian discharged soldier), good technical and practical training, 10 years' experience in electrical installations in Belgium, France, England, going back to Belgium shortly, would like to hear of British firms desirous to start business or agencies there.—A. COLLUMBIEN, 2, Woodlands Road, Cheetham Hill, Manchester. 6354

CABLE Agency, Yorkshire district. Wanted by C.M.A. member, Agent for Rubber Cables.—3691, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMMERCIAL and Practical Electrical Engineer, with valuable connection in Lancashire and Yorkshire, offices and stores in central position, Manchester, open to consider Agencies of high-grade Electrical Supplies for manufacturers.—6401, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineers, with offices in Manchester, are desirous of representing manufacturers of all types of electrical goods.—6344, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Goods (Export).—Electrical Engineer (French), 10 years with important company in Paris, wishes to represent first-class English house desirous of extending in France.—L. LODI, 17, Rue Peligot, Enghien, near Paris. 6203

FIRM of merchants and agents in Glasgow, with valuable connection throughout Scotland, are open to consider agencies for high grade electrical material.—6132, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GENTLEMAN, shortly returning to Belgium, desires Agency for Pocket Flash Lamps and Sundries; also small electrical appliances; good pre-war connection in the line.—6378, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GLASGOW Electrical Firm is desirous of representing manufacturers of Electrical Specialities, Labour-saving Tools, &c. Excellent showroom, storage accommodation and connection.—6200, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

JAPAN.—Will representatives of Japanese Manufactures, particularly accessories and cables, communicate with Advertiser with a view to business?—6390, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

LOCAL Agents wanted in every town to represent the Cleveland Metal Co., Ltd., Bridge Works, Stockton-on-Tees, makers of White's Patent Controller Fingers, and Controller Fingers and Segments for all types of Controllers. Commission basis only.—6231, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES.—*Continued.*

MACDONALD, Syer & Co., Ltd., 295, Gray's Inn Road, London, are open to represent manufacturers of Motors, Switchgear and Electrical Fittings generally. 3367

MANCHESTER Electrical Firm, with good show and store rooms, require Agencies for Motors, Dynamos, Switchgear and Conduit. First-class connections.—3485, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

NEW Zealand firm, established connection, representative now in England, will consider Agency proposals from makers of Accumulators, Motor Control Gear, and Telephone Apparatus.—6417, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

OLD-established electrical firm, with offices and stores in London, are open for agencies. Good connection among engineers, architects, builders and householders.—3553, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

OVERSEAS and Home Trade.—Wanted at once live Agencies for a well-known make of Secondary Batteries, all types and sizes from 1·5 ampere hours to 500 ampere hours; also Travellers to take up and thoroughly work the South and South-West of England.—6359, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

REPRESENTATIVE for Lift and Hoist Engineers required in London, Liverpool, Birmingham, Bristol and other large towns. Electrical contractors suitable.—3557, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SOLE Agents required in large towns for patent apparatus converting any make of hand lift or crane to power by utilising existing gearing without alteration. Many already in use. Firms applying must be able to supply and fix the necessary electrical equipment and erect the patent Deplaro, which will be supplied on satisfactory terms.—PICKERING HOIST CO., Parliament Mansions, Victoria Street, London, S.W. 1. 3405

TO Electrical Manufacturers.—Representative (Electrical Engineer), good connection in Lancashire and Yorkshire, requires speciality lines or agencies, lamps, flash lamps, A.C. or D.C. equipment, accessories. New ground worked. Expenses and commission.—6369, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR SALE.

MACHINERY FOR SALE.

SEVERAL ¼-H.P., totally-enclosed, 100-volt, 1500 and 2000 revs., new D.C. Motors.

Several ¾-H.P. and 1-H.P., 200/240-volt, new D.C. Motors, with pulleys and starters.

Several 2½-H.P. and 3-H.P., 460/480-volt, D.C. Motors, with pulleys and starters.

One 25-H.P., 500-volt, 1180 revs., shunt-wound, protected-type Motor, with pulley and semi-enclosed starter, 1/20 H.P. at 980 revs.

Two 5-H.P., 200/240-volt, 1350 revs., shunt-wound, protected-type, D.C. Motors, with pulleys and starter; also one 10-H.P., do., 950 revs., enclosed-ventilated, fan-cooled Motor, complete.

6-H.P., 100-volt, D.C. Motor, with pulley and starter, in good running order, price £34, f.o.r. London.

3-H.P. 380-volt, single-phase Motor, slip-ring type, with enclosed gears at 130 revs., complete with starter.

One 2-H.P. 346-volt, 50-cycle, 3-phase, slip-ring Motor, 950 revs., with pulley and starter.

One 12, 7½, 6 and two 3-H.P. 200-volt, 50-cycle, single-phase slip-ring Brooks Mootors, with pulleys, and enclosed Ellison's starter, fitted with no-volt and over-load releases.

Several 25-H.P., 480-volt, D.C. Motors, by Siemens, General Electric Co., and Lancashire Dynamo & Motor Co., at low speeds, with pulleys and starters; also several 7½, 10 and 12-H.P. machines.

C. J. FERGUSON & SONS,
54, Chiswell Street, E.C. 1. 3544

FOR SALE.

250-KW. Belliss-E.C.C. Set, comprising Belliss high-speed, 3-crank, compound engine, direct-coupled to E.C.C. generator, 440/460 volts, D.C., 560 amps., 380 R.P.M., with Körting ejector compound, also spare armature. Can be seen running by appointment.—BURY ELECTRICAL PLANT CO., LTD., Phœnix Street, Bury. 2746

SPECIAL MOTOR AND GEAR.

40-H.P., D.C., 440/500 v., back gear, silent pinion; complete with starting panel, D.C. starter, switch fuses and meter.

30-H.P. Interpole Machine, D.C., 440 v., complete with D.A. starter and switch. Immediate delivery guaranteed.

"ROBUST MACHINERY,"
62, Bradford Street, Walsall. 3313

(Continued on next page.)

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

NO. 2 Direct-acting Steam-driven Air Compressor, 16″ × 16″ × 18″, by the Ingersol Sargeant Drill Co.

Hori. Direct-acting Air Compressor, by the Ingersol Sargeant Drill Co., 12″ × 12″ × 12″.

14″ Hori. Air Compressor, by the Chicago Pneumatic Tool Company.

25-KW. Steam Generating Set, two crank Compound Engines direct coupled to 2-pole dynamo, 100 volts, 250 amps., 450 revs.

6·5-KW. Steam-driven Generating Set, by Robey & Co., direct coupled to 2-pole dynamo, 130 volts, 50 amps., 350 revs.

Compound-wound Bi-polar Dynamo, by Scott Mountain, 220 volts, 450 amps., 550 revs.

Hydraulic Cement Flag-making Plant, by H. Berry & Co., with intensifier.

Direct-acting Pump, 16″ × 9″ × 10″, brass fitted with 5″ suction, 4″ delivery, by Guild & Garrison, U.S.A.

Compound Smith Vale Duplex Pump, 8″ and 12″ steam cyls., 12″ water cyl., 10″ stroke, brass fitted with 12″ suction, 8″ delivery.

CATALOGUE of Stock MACHINERY. 2-3000 LOTS.
Free on Application. Inspection invited.

THOS. W. WARD, LTD., ALBION WORKS,
Tel.: "Forward, Sheffield." SHEFFIELD.

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and at Milburn House, Newcastle-on-Tyne.

Tel: { 44 Wakefield. / 867 Newcastle. } Telegrams: "Engineer, Wakefield."

FOR SALE.

ONE Parsons Steam Turbo, 1500 KW., 2-phase, 2000 volts, 50 periods. Complete with condensing plant.

One Willans-Parsons Steam Turbo Set, 1200 KW., with Alternator, 1200 R.P.M., 200 lbs. to sq. in., 11,000 volts, three-phase, complete with exciter, also condensing plant, air, and circulating water pumps, &c.

One 500-KW. triple-expansion Set, engine by Browett and Lindley, H.P. cyl. 17½″, I.P. 25″, L.P. 35″ × 14″ stroke. Single-phase Alternator, by British Westinghouse Co., 2100 volts, complete with exciter, &c.

One 225-KW. Generating Set, engine tandem comp. type, 300 H.P., with Corliss Valve Gear, &c., B.T.H. Generator, 500 volts, compound wound.

One Surface Condenser, by J. & H. McLaren, capacity 3000 cls. per hour, with circulating pump.

Two Exciters, 180 volts, 80/100 amps., 200 R.P.M. 5277

MACHINERY, &c., FOR SALE.

FOR Sale, Generator or Motor, 110-volt, 164 amps. D.C., 950 R.P.M., three-bearing machine.

1, 5, 10, 15, 18, 25 and 30 H.P., D.C., 220 v. and 440 v.

1, 2, 3, 5, 10, 15, 25, 30, 35-H.P., A.C., 2 and 3-phase, 220 and 440 v., Starting and Switchgear.

Four miles 1/18, five miles 3/22, 3/20, 7/20, 7/18, 7/14, 7/16, 19/16, 37/16. Association and Non-Association, 600 meg.

D.P. and T.P. Switch Fuses, 15 to 200 amp. D.P. Fuse Boards, 10/20 amp. per way. Iron-clad, Home Office Pattern, 4 to 12 way.

Immediate delivery and all guaranteed. In stock for inspection. Your enquiries please.

"ROBUST MACHINERY,"
62, Bradford Street, Walsall.
3563

MOTORS FOR SALE OR HIRE.

One	12	H.P.,	200	v., D.C.	Two	10	H.P.,	110 v., D.C.
,,	10	,,	200	,,	One	11	,,	110 ,,
,,	3	,,	240	,,	,,	2	,,	200 v., 50 per., A.C
Two	5	,,	480	,,	,,	3	,,	200 ,, ,,
One	3	,,	480	,,	,,	3	,,	400 ,, ,,
,,	8	,,	440	,,	,,	8	,,	400 ,, ,,
,,	6	,,	400	,,	,,	9	,,	400 ,, ,,
,,	15	,,	480	,,	,,	10	,,	200 ,, ,,

All machines are in good condition and complete with starters and pulleys.

'Phone: Avenue 7090. H. RYAN, 121, Middlesex Street, London, E. 1. 6300

MACHINERY FOR SALE.

THREE 3-H.P. and 5-H.P. 400-volt, 3-phase, 50 cycles; new machines; without certificate.

YORKSHIRE ELECTRIC WIRING & MOTOR CO., LTD.,
4, Lady's Bridge,
Sheffield. 3533

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

D.C. MOTORS.

H.P.	Volts.	R.P.M.	Windings.	Makers.	Type.
30	400/440	850	Shunt intple.	Royce Bros.	Encl's'd, v'ntilat'd.
27	460/480	950	,, ,,	Brush Elec.	,, ,,
20	440/460	750	,, ,,	Bruce Peebles	,, ,,
20	440/460	1250	,, ,,	E.C.C.	Tot. en., pipe vent.
15	230	800	,, ,,	Royce Bros.	Encl's'd, v'ntilat'd.
13	400/420	1000	Shunt wo'nd.	Mather & Platt.	Totally enclosed.
12	200/220	950	,, ,,	Cutting Bros.	Encl's'd, v'ntilat'd.
10	420	1000	,, ,,	Electromotors.	,, ,,
10	400/440	750	Shunt intple.	,,	Totally enclosed.
9½	400/460	750	,, ,,	E.C.C.	,, ,,
8	230	480	,, ,,	Royce Bros.	Encl's'd, v'ntilat'd.
8	440	950	Shunt wo'nd.	Gen. Elec. Co.	Tot. en., reversing.
7½	440	880	,, ,,	Siemens Bros.	Encl's'd, v'ntilat'd.
7½	230	880	,, ,,	,, ,,	Totally enclosed.
5	230	880	,, ,,	,, ,,	Encl's'd, v'ntilat'd.
5	440/460	1200	,, ,,	Cutting Bros.	,, ,,
4	400	1150/1835 variable.	,, ,,	Gen. Elec. Co.	,, ,,

A.C. MOTORS.

H.P.	Volts.	R.P.M.	Periods.	Phase.	Makers.	Type.
30	400	750	50	Three.	Clayton Motors.	Encl's'd v'ntilat'd.
12	420	960	50	,,	Gen. Elec. Co.	,, ,,
10	440	950	50	,,	Brook & Co.	Tot. en., pipe vent.
5	420	1450	50	,,	Wright & Wood.	Encl's'd v'ntilat'd.
3	420	1450	50	,,	,, ,,	,, ,,

GENERATORS.

17 KW., 230 volts, 1200 R.P.M., shunt wound, Holmes & Co., makers, enclosed, ventilated type.

300 watt, 160 volts, 1250 R.P.M., shunt wound.

YARNALL & CO.,
Cornwall Street Ironworks,
Openshaw, Manchester. 3259

GENERATING SETS FOR SALE.

TWO 500-KW. Belliss & Morcom-Bruce Peebles, 500 volts, D.C.

One 150-KW. Belliss & Morcom-Bruce Peebles, 500 volts, D.C.

One 500-KW. Browett, Lindley-Bruce Peebles, 500 volts, D.C.

One 150-KW. Belliss & Morcom-Silvertown, 220 volts, D.C.

Two 178-KW. Scott & Mountain's, 220 volts, D.C.

For particulars, apply,
ROBERT WALKER,
2, Oswald Street,
Glasgow. 3503

FOR IMMEDIATE SALE.

THREE A.C. Generating Sets, comprising compound double-acting high-speed Engines ("Sentinel"), 220 B.H.P. each, coupled direct to 150-KW. Generators (Westinghouse), 440 volts, 25 periods, three-phase.

Two D.C. Generating Sets; compound, double-acting high-speed Engines ("Sentinel"), 45 B.H.P., coupled direct to 30-KW. Generators (Westinghouse), volts 250.

Four Durr Water-tube Boilers, 1614 sq. ft. H.S. each; working Press 120 lbs. per sq. in.

One Main Switchboard and Accessories, &c.

All in good order.

For further particulars, apply to WM. D. HAMILTON, Consulting Engineer, 59, Bath Street, Glasgow. 3239

ELECTRICAL PLANT FOR SALE.

ONE 300-KW., 220/250-volt Generating Set, comprising "Howden" enclosed compound engine, coupled to compound interpole Generator.

One 500-KW., 220/250-volt Generating Set, comprising "Belliss" enclosed compound engine coupled to compound-wound Generator, and complete with condensing plant.

One 450-KW., 500-volt Set, as above, with or without condensing plant.

THE PHŒNIX ELECTRICAL CO.,
32—36, Broomielaw,
Glasgow. 2429

ELECTRIC DYNAMOS AND MOTORS.

MACHINES always available for Sale or hire.
ARMATURES and FIELD COILS
rewound or repaired without delay.

'Phone: 5773 Holborn. MACDONALD, SYER & CO., LTD., 295, Gray's Inn Road, W.C. 1. 8485

(*Continued on next page.*)

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

TURBOS AND GENERATING SETS.

1000-KW. Turbo-Generator, A.E.G., 500 volts, 50-period, 3-phase, complete with two switch panels, surface condenser, electrically-driven air and circulating pumps, together with the piping and a quantity of new spare parts. The whole practically equal to new and ready for immediate despatch at Liverpool.

500-KW. Parsons Steam Turbo, 460/500 volts, D.C., in perfect condition, and complete with condensing plant.

Also 256, 200, 185, 160, 120 and 48-KW. Bellias Generating Sets, 460/500 volts and 220 volts, D.C.

One 200-KW. Allen-Holmes-Clayton, 500-volt, 50-period, 3-phase.

MOTORS.

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FOR SALE.—*Continued.*

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Five 3-H.P. " " 1200 "
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(*Continued on next page.*)

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

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FOR SALE.—*Continued.*

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2,000 Pocket Lamp Cases.

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(*Continued on next page.*)

FOR SALE.—*Continued.*

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D.C. MOTOR-Generators, 460 v. to 70 v., 80 a.; ditto, 70 v.. 70 a.; ditto, 230 v. to 50 v., 50 a. D.C. Motors, 230 v., 3 H.P., £22 10s.; 1½ H.P., £16 10s.; ¾ H.P., £12 10s.; ½ H.P., £9. Dynamo, 100 v., 100 a., £40. ½-H.P., 200 v., 100-cycle S.P. Motor, £8 15s.—"ELECTRICAL," 5, Osborne Terrace, Gosforth, Newcastle-on-Tyne. 6415

D.C. Motors 110 v., ½/25 H.P.; 230 v., ½/40 H.P.; 460 v., ½/150 H.P., D.C. Starters, to 150 H.P., shunt regulators, any size, good delivery. Panels, Voltmeters, Ammeters.—6413, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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DYNAMO, heavy, by Paterson & Cooper, 105 v., 30 a., shunt-wound, open type; commutator as new. Reliable machine. Good condition. F.o.r., £25.—RUSSEL, Stoke Road, Aylesbury. 6408

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FOR SALE.—*Continued.*

FOR Sale, Browett-Lindley 110-KW. Generating Set, 460/500 volt D.C. In first-class order.—SHEERNESS AND DISTRICT ELECTRIC POWER AND TRACTION CO., LTD., Sheerness East, Kent. 3420

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FOR Sale, Generating Set, composed of 65-H.P. gas engine, compressed air starter, coupled direct to 40-KW., 6-pole machine; perfect order; as new; 250 volts. Also 10" centre, 12' gap bed S.S. & S.C. Lathe, with change wheels and 4-jaw chuck.—GEO. DEAN, Stockton Brook, Stoke-on-Trent. 6339

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FOR Sale, 10-ton Electric "Goliath" Drane, 36 ft. span, also 5-ton, three-motor Overhead Travelling Crane, 38½ ft. span, with 220-volt, D.C. Motors.—THE PHŒNIX ELECTRICAL Co., 32/36, Broomielaw, Glasgow. 3379

FOR Sale, 30-H.P., D.C., 440-volt Motor, 680 R.P.M. Nearly new. Can be seen running.—Apply, E. T. MACKRILL & SONS, Aylesbury. 3517

FOR Sale, 68-KW., direct coupled, Steam Set, 500 volts, ditto 140 volts.—WILLIAMS & SONS, 37, Queen Victoria Street, London. 3484

FOR Sale, 75 and 110-KW. 220/240-volt. Multipolar-Generators, also several Motors to suit, 7½ to 18 H.P.—THE PHŒNIX ELECTRICAL Co.. 32/36, Broomielaw, Glasgow. 3378

FOR Sale, 105-volt, 200-amp., 800 R.P.M. Crompton Generator, complete; 2-pole Shunt Dynamo, Parker, 140 volts, 40 amps., 1,200 R.P.M., with pulley and spare Armature; 7½-B.H.P., 460-volt, Crompton Motor with pulley and rails; 2-B.H.P., 200-volt, single-phase, 50 cycles, 1,400 R.P.M. Motor.—3509, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, 110-KW. direct coupled Steam Generating Set, Siemens type dynamo, 220 volts, immediate delivery.—WILLIAMS AND SONS, 37, Queen Victoria St., London. 3483

FOR Sale, 200 H.P. 3-phase motor, 50 cycles, 500 volts, with bedplate, pulley, resistance and controller. Would exchange for suitable totally enclosed motor.—G. & T. EARLE (1912), LTD., Wilmington, Hull. 3463

FOR Sale, 210-H.P. Motor, 460 volts, 425 R.P.M., with interpoles. 130-H.P. ditto, 500 volts, 650 R.P.M. Prompt delivery.—WILLIAMS & SONS, 37, Queen Victoria Street, London. 3481

(*Continued on next page.*)

FOR SALE.—*Continued.*

FOR Sale, 250-H.P., 500-volt, 50-period, 3-phase Motor, complete with starting gear.—3473, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, 1000-KW., 500-volt, D.C. Turbo-Generator and auxiliaries, new 1912, and in first-class condition.—THE PHŒNIX ELECTRICAL CO., 32/36, Broomielaw, Glasgow. 3587

GENERATING Set comprising 12 N.H.P. Loco. type Boiler with feed water heater; Duplex Steam Pump, 12 N.H.P.; Compound Steam Engine by Davey, Paxman & Co., coupled direct to 200-volt, D.C.; Generator by the Lancashire Dynamo and Motor Co., speed 130 R.P.M., 6-pole type.—STANLEY ENGINEERING CO., Bath. 3443

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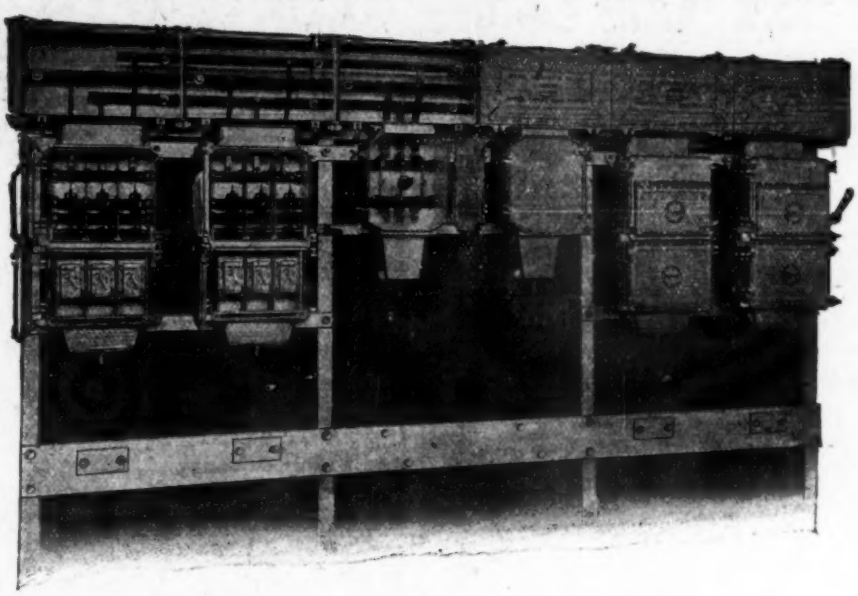

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Electricity Supply Committee's Offices,
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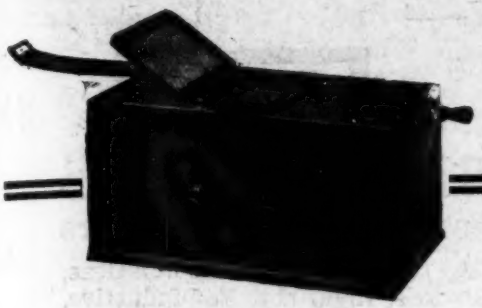

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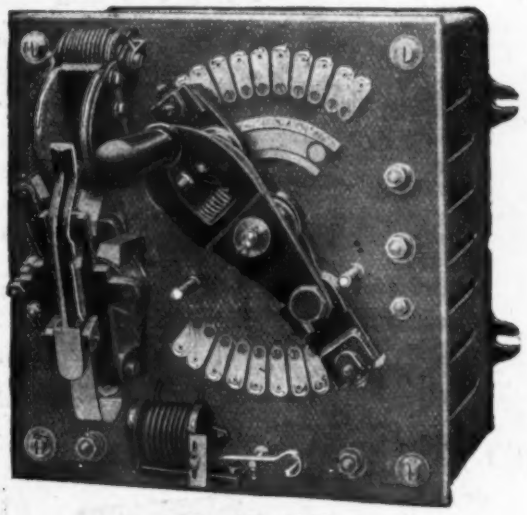

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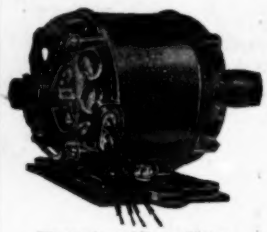

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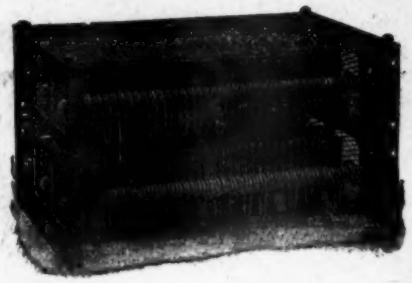

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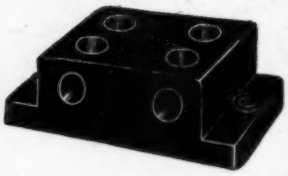

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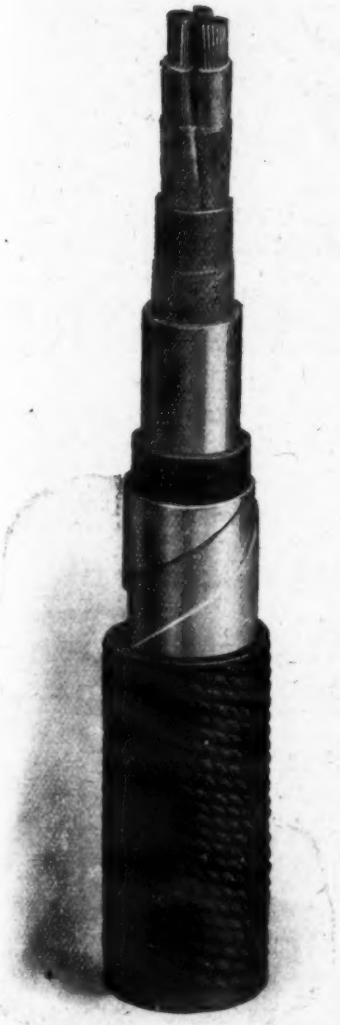

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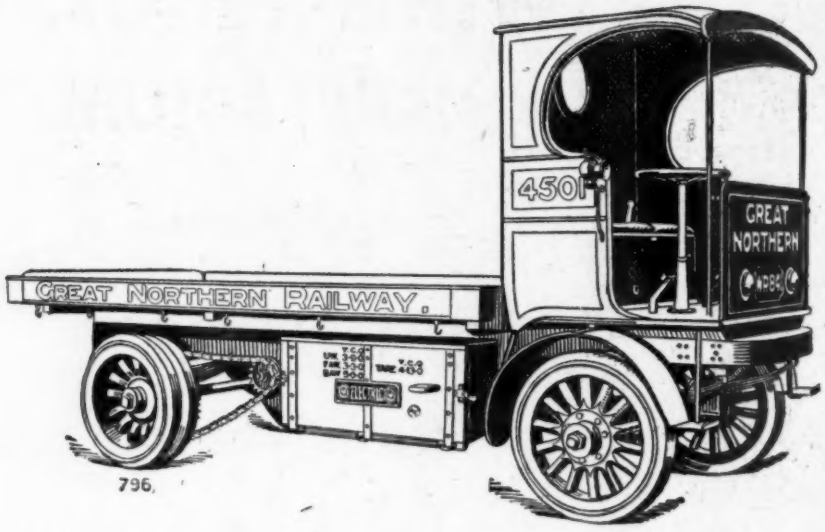

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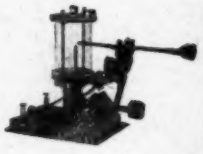

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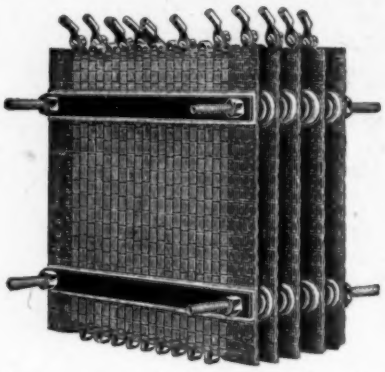

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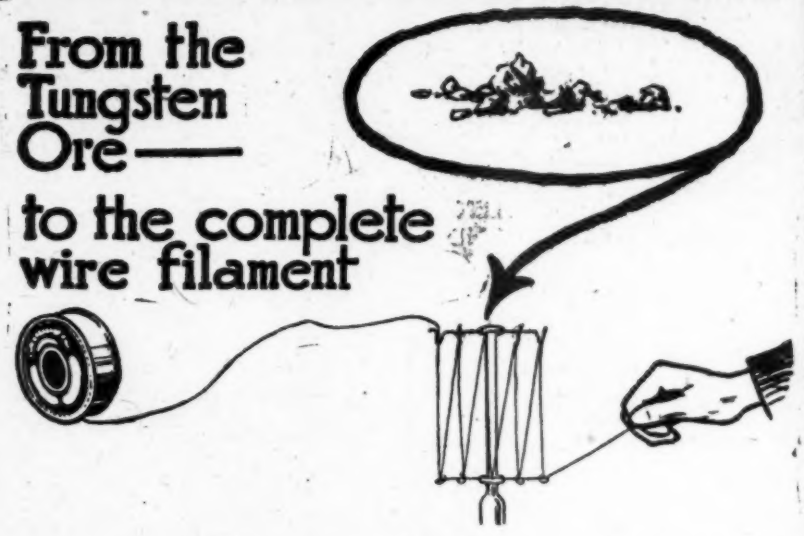

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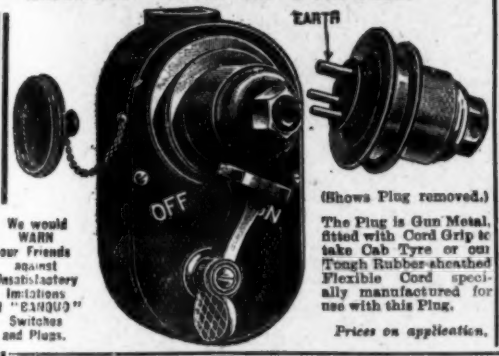

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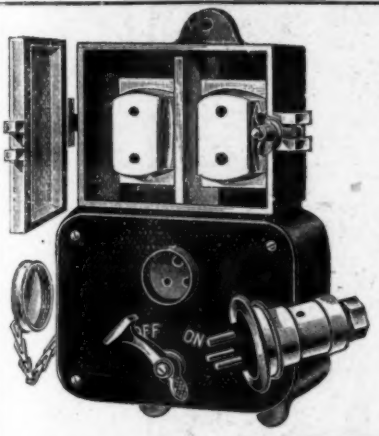

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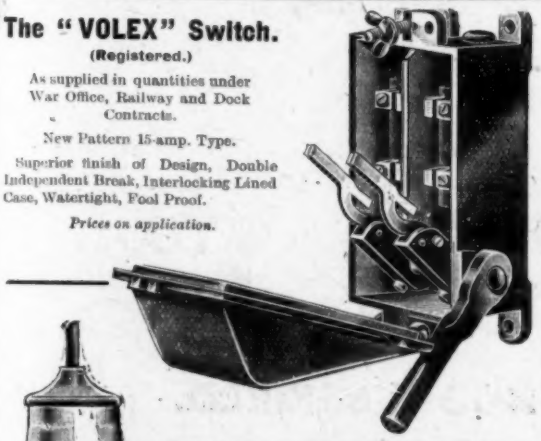

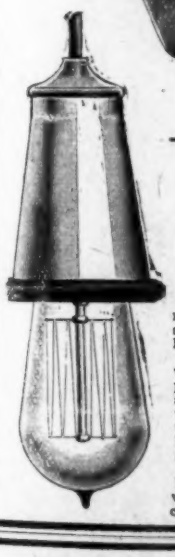

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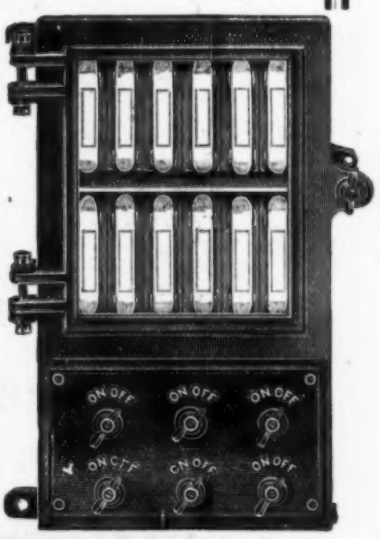

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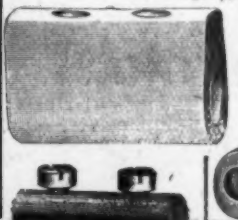

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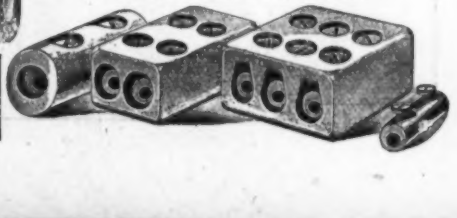

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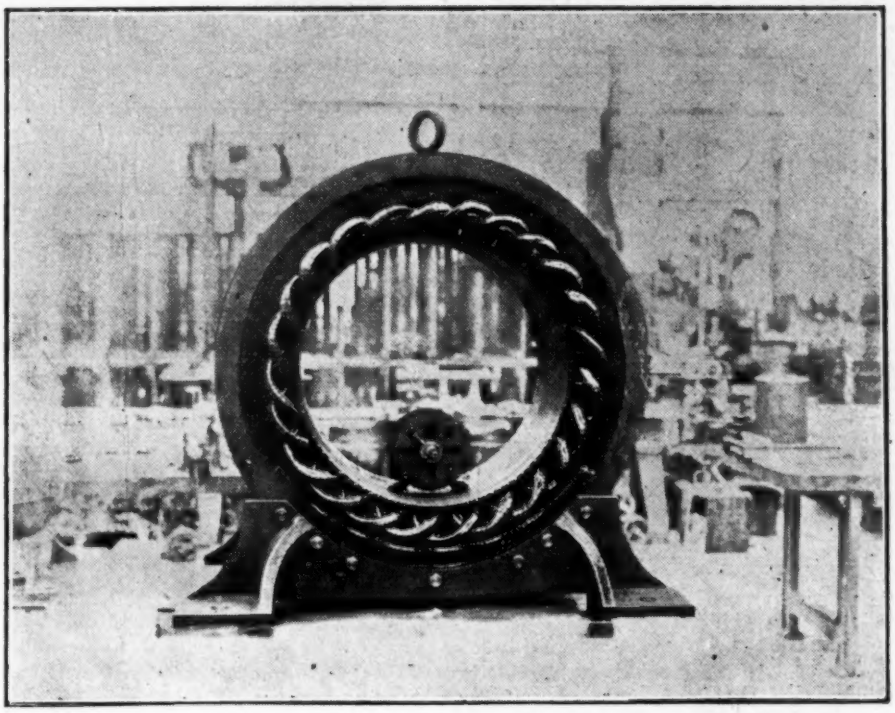

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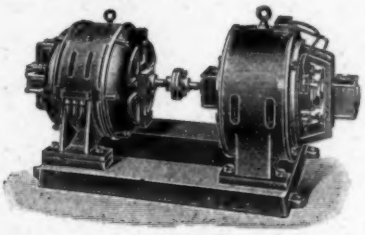

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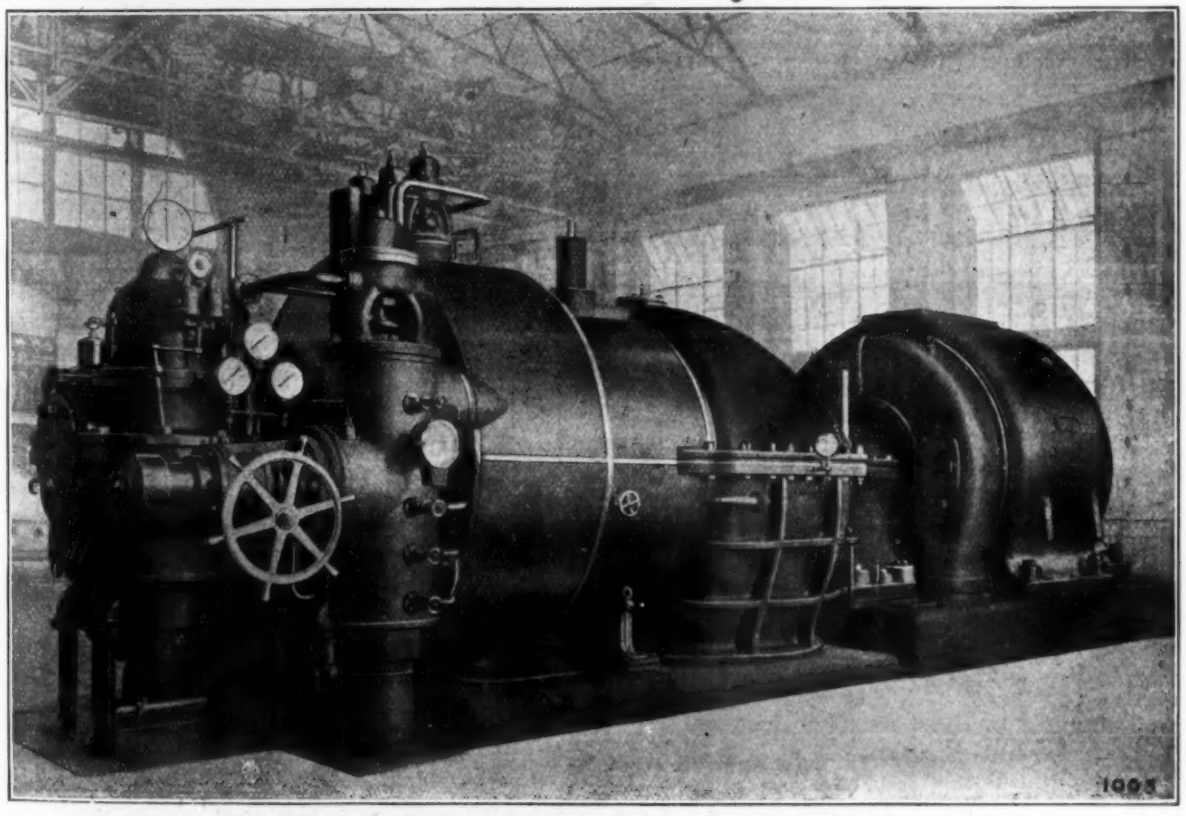

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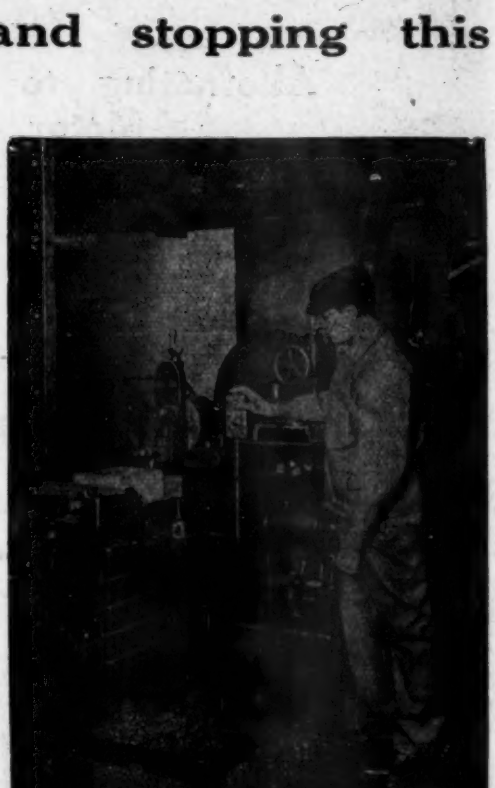

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Stirling.—Year's Working.—For the year ended May 15th, 1918, the gross profit of the Burgh Electricity Department was £2,582. The income amounted to £7,504, and the expenditure to £4,922. After paying interest on loans, £860, redemption of debt, £1,266, and other capital charges, the net surplus was £82; this was carried to the reserve fund, which now stands at £2,059; 461,816 units were generated, against 448,877, and 434,012, against 421,758, were sold. The maximum demand was 277 kw., against 252 kw.

Stoke-on-Trent.—Proposed Extensions.—The Electricity Committee has received letters from Sir John Snell and the Director of Electric Power Supply, stating that the scheme for plant extensions had been approved by the War Cabinet Electric Services Sub-Committee, and the engineer has been instructed to prepare a report as to suitable sites, &c., for the new generating station.

Warrington.—Supply to Tanneries.—The B. of T. has granted an order enabling the T.C. to supply electricity to the Orford Tanneries, which are in the area of the R.D.C.

West Bromwich.—Linking-up.—Arrangements have been made for the linking-up of the electricity undertakings of the Corporation and the Midland E.P. Co., so that the former can obtain energy from the company when it is unremunerative to run its own plant.

Wolverhampton.—Loan Sanction.—The L.G.B. has sanctioned the borrowing by the Corporation of £10,000 for contingencies in connection with extensions to the electricity undertaking, and £100 for the extension of electricity mains.

TRAMWAY AND RAILWAY NOTES.

Christmas Day Services.—It has been decided to suspend the tramway services at Manchester, Salford, Birmingham, and several other towns, on Christmas Day.

Doncaster.—New Cars.—The Tramways Committee has ordered ten new tramcars, on the understanding that if priority of manufacture cannot be obtained the order shall be cancelled.

Hull.—Temporary Employés.—At the last meeting of the Tramway Committee the manager reported that application for the release of men from the Forces had been made, but he found that the machinery for releasing them had not yet been set in operation. He proposed that, as they were released, they should resume the positions they had vacated. The women would be the first to go, and those who had the least length of service would be the first to leave. They would be followed by the senior women, and then by the temporary men, in the same order.

Electric Vehicle.—The T.C. has decided to purchase a 20-cwt. electric truck for the collection of street refuse.

London.—L.C.C.—It is stated in the daily Press that, in view of their exceptional work on Armistice Day, £5,000 has been distributed amongst the L.C.C. tramcar drivers and conductors.

Wages.—The Highways Committee has recommended that the application of the National Transport Workers' Federation for 5s. per week, which has been awarded by the Committee on Production, be granted to the tramway employés concerned; the cost is estimated at £110,000 per annum.

The Metropolitan Electric Tramway Co.'s male employés have also been granted the 5s. per week extra.

On Wednesday the daily Press announced that the National Transport Workers' Federation was making immediate application for a further increase of 10s. per week on the war wages of its members; an eight-hour day, a 5½-day week, time-and-a-half rates for overtime, and double pay on Sundays are also demanded.

L.U.T.—On Tuesday evening the L.U.T. tramway service was considerably disorganised through the breaking of a trolley wire at Kew Bridge. For some time the service was maintained over a single line on one section.

Collision.—An L.C.C. tramcar collided with another car that was standing at the Abbey Wood terminus on Sunday night, both cars being badly damaged. Three persons were injured, one badly.

Maidstone.—Proposed Extension.—The T.C. is considering the question of extending the tramways in the North and South King Street Wards; the proposed new line will be 1¼ miles in length.

Market Drayton.—Proposed Light Railway.—Plans for the construction of a light railway between Shrewsbury and Market Drayton have been deposited with the R.D.C.

Middlesbrough.—Proposed Extensions.—The Corporation has notified its intention of applying for powers to construct a tramway to the Stockton borough boundary; the Stockton T.C. has decided to oppose the application.

Railway Nationalisation.—Speaking at Dundee, on Wednesday last week, Mr. Churchill stated that it was part of the Government policy to nationalise the railways; that great step it had at last decided to take. It was decided not to nationalise shipping. We may add that the total capital-account expenditure of the 38 principal railways in the United Kingdom was £1,120,542,271, with net receipts of £46,376,941, for the year ending December 31st, 1916.

Railwaymen's Eight-hour Day.—An official announcement was issued on Saturday stating that the principle of an eight-hour day for all members of the wages staff of British railways, including Ireland, had been conceded by the Government as the result of a Conference at the B. of T. on Friday last, and is to come into operation on February 1st next. All existing conditions of service are to remain unaltered, pending the decision of a Committee of both sides, to be set up as soon as possible to review wages and other conditions of service of railwaymen in Great Britain. Mr. J. H. Thomas, general secretary of the National Union of Railwaymen, is reported to have said that "it must be clearly understood that the eight-hour principle is not established for the purpose of enabling overtime to be worked. It is to be a maximum working day." Other items in the after-war programme of the N.U.R. include the payment of the pre-war rate of wages, with the addition of the present war bonus of 30s. per week, plus 10s. per week; the payment of time-and-a-half rates for overtime and nightwork, and double pay for Sunday work; and 14 days' holiday each year, with full wages.

St. Helens.—Tramway Control.—The T.C. has decided to take over the undertaking of the New St. Helens and District Tramways Co. at the expiration of the lease in October, 1919, and a Committee has been formed for the working of the same.

Southend.—Coal.—The Corporation has obtained a supply of coal which will enable a full service of tramcars to be run.

Stockton.—Proposed Extensions.—The Corporation has decided to apply to Parliament in the ensuing session for powers to extend the tramways to Port Clarence.

Underground Railways.—Overcrowding.—There is no hope of relief from the nightly squash on the underground railways till more material and skilled labour are available. There are three main causes of the overcrowding, they are:—London is crowded more densely than ever before; thousands of unaccustomed travellers—chiefly war-work girls, visitors to London, and soldiers passing through; people have the habit of going home earlier. Mr. Blake, superintendent of the line, is reported to have stated that the company is running not a train less than in 1914. No fewer than 1,046 trains pass every day, either Eastward or Westward, through the tunnel at St. James's Park; 25 per cent. more trains, both on the tubes and the District and Circle systems, could be put on, that would make all the difference, but it cannot be done till rolling stock is available. The tubes are actually running 22 motor-coaches and 23 trailers more than at the beginning of the war. The aim of the organisers is to obtain enough additional rolling stock to turn every five-coach into a six-coach train; 7,000 soldiers arrive at Victoria every day on leave, and they mostly use the underground railways to reach the terminal stations.

York.—Fare Revision.—The Tramways Committee has increased all the tramway fares by ½d.; workmen's fares remain as before.

TELEGRAPH AND TELEPHONE NOTES.

Argentina.—The Argentine Government has issued a decree granting the Central and South American Telegraph Co. the right to lay, operate, and maintain lines and cables connecting the Argentine Republic with Montevideo, Uruguay. The Uruguayan Government has also issued a decree granting the Central and South American Telegraph Co. the right to lay, maintain, and operate lines of telegraph and cable to connect Uruguay with Argentina. The Central and South American Telegraph Co. has all of the material on hand at Buenos Aires for the connections between the cable landings and its offices at Buenos Aires and Montevideo. It has also under contract the necessary length of cable over 70 miles to make the submarine connections. It is expected that the work will be completed within nine months. On November 1st the President of Brazil signed a concession granting the Central and South American Telegraph Co. the right to establish cable communication between Rio de Janeiro and Cuba, touching at places in northern Brazil and possibly the West Indies. The company has already two cables connecting New York with Guantanamo, Cuba, thence to Colon, Panama.—*T. and T. Age.*

Australia.—A new regulation requires that all vessels of over 1,600 tons registered in Australia or trading on the coast (passenger or cargo) shall be installed with wireless equipment. The apparatus must be in charge of competent, certificated operators, and it must be capable of transmitting and receiving messages over a distance of at least 150 miles by day or night; it must also include emergency transmitting apparatus which can be operated independently of the power supply of the vessel, with a range of not less than 100 miles by day, and capable of working continuously for six hours. The Naval Board may exempt any vessel. Non-compliance with the regulations makes the master, owner' agents, and charterers of the vessel severally guilty of an offence. —*Age.*

The building which is to house the new City North Telephone Exchange was due for completion in October last. It will be the

first automatic exchange in the Sydney City area, and its ultimate capacity will be 20,000 subscribers. The first instalment of apparatus will deal with 2,500 subscribers, 1,100 lines being connected, having 1,700 instruments in use. It is expected that the exchange will be in operation in 12 months' time. The total cost of the equipment will be £78,000.

China.—A contract has been signed between the Chinese Government and the Marconi Wireless Co., to supply three wireless stations, each of a capacity of 25 KW. This gains for the British Wireless Co. its first footing in China. Several wireless stations have been erected in the past by Germans, but these never were used commercially. The Marconi stations will be erected in widely separated parts of the Republic like Kashgar, Urumchi, and Lanchowfu for commercial purposes, with the aid of a smaller station at Sianfu, and will exceed in power and range any others in the Republic.—*The Times.*

Cook Islands.—A wireless station has been established at Rarotonga, and was opened for traffic on September 9th last. The provision of wireless telegraph facilities has been under discussion for some years, the residents urging that the absence of any means of communication with the outside world has been the cause of much loss in the fruit and export trade. In July, 1916, the fruit exporters agreed to pay a duty of 1d. a case on fruit, amounting to about £700 a year, to provide for the maintenance of a wireless plant, and this duty has apparently been collected ever since, though the plant has only now been brought into operation.—*Auckland Weekly News.*

United States.—Mr. Daniels, Secretary of the Navy, has declared that he is in favour of a Government monopoly of all wireless stations in the United States and its possessions. The hearing of the Bill to take over the stations was to begin before the House Merchant Marine Committee yesterday. The Navy approves the Bill, which is opposed by the American Marconi Co. backed by the British Marconi Co. The American company is anxious to retain two high-powered plants on the Atlantic coast, which are apparently part of a plan to create a wireless link between England, the United States, and the Orient.

Mr. Vail, acting adviser to the Postmaster-General in organising cable systems under Government control, in a tentative report declares that the American cable system must be organised and freed from the uncertainties of foreign control. There must be an American system placing the country in direct communication with every country with which America hopes to have important commercial relations, and that there is immediate necessity for a cable on the east coast of South America to give America and the River Plate countries direct communication.—*Financier.*

CONTRACTS OPEN AND CLOSED.

OPEN.

Australia.—SYDNEY.—April 28th. City Council. Supply and erection of power house switchgear. Specifications from Electric Lighting Department, Town Hall, Sydney.

Victorian Railways Department.—January 15th. Supply of battery cells. Particulars from Agent-General for Victoria, London, S.W.

Dublin.—December 23rd. Electric Supply Committee. 200 single-phase and 100 three-phase, A.C. meters. See "Official Notices" to-day.

Luton.—B.C. Electric lighting installation at Town Hall and Market Place. Borough Surveyor.

CLOSED.

Australia.—MALVERN.—Installation of an automatic switchboard equipment at the telephone exchange, and for the supply of apparatus and material in connection with Brighton Exchange, £41,998. Automatic Telephones (Australasia), Ltd.

P.M.G.'s Department, Victoria—
274 miles, twisted pair, o.s., 18 s.w.g., distributing wire, £5,690; 31 miles twisted pair, o.s., 16 s.w.g., distributing wire, £815; 41 miles, single twisted, R.I., 18 s.w.g. wire, £582; 57,050 copper jointing sleeves, £369.—Western Electric Co. (Aust.), Ltd.
25 tons, G.I., 15 lb. wire, £1,500.—R. Johnson, Clapham & Morris, Ltd.
5,000 dry cells, £1,187.—J. McIlwraith & Co., Pty., Ltd.
Electric vehicle, £675.—Australian General Electric Co.

Victorian Railways Department—
Incandescent electric carbon filament lamps (Dutch manufacture), 16 c.p., 220 v., 2s. 2d. each; 25 c.p., 220 v., 2s. 3d. each.—H. Rowe & Co.

P.M.G.'s Department, Western Australia—
10 miles, twisted pair, V.I.R. wire, £220.—B.I. & Helsby Cables, Ltd.

P.M.G.'s Department, N.S.W.—
100 relays, 500 ohms, 120 83½ ohms, 200 50 ohms, £207.—Automatic Telephones (Aust.), Ltd.

P.M.G.'s Department, Tasmania—
45 Chloride accumulators, with spare parts, £219.—W. G. Watson & Co., Ltd.

Victorian Railways Department—
Electric incandescent metallic filament lamps, 2s. 2d. each.—Australian General Electric Co., Ltd.; do., do., 2s. 6d. each.—Edison Swan Electric Co., Ltd.

—*Tenders.*

Spain.—The Sociedad Minera y Metalurgica de Penarroya has lately placed a contract with Messrs. Piccard-Pictet & Co., of Geneva, for four 5,500-H.P. Francis turbines, in connection with the extension of its hydro-electric generating station.

Stretford.—U.D.C.:—
H.T. switchgear, £2,090.—British Westinghouse Co.
L.T. switchgear, £2,422.—Bertram Thomas.

Wolverhampton.—T.C.:—
Five boiler feed regulators, £247.—Crosby, Ltd.
Brickwork for new boilers, £200.—Windsor & Co.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, December 13th. At 7.30 p.m. At 39, Victoria Street, S.W. Lecturette "Air Compressing," by H. P. Anderson. Adjourned annual general meeting.

Friday, December 20th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Presidential address by Col. R. E. B. Crompton, C.B. "What war has done for Engineers and the part Engineers will have to play in Reconstruction."

(Midland Section).—Friday, December 20th. At 7.45 p.m. At the University, Birmingham. Paper on "The Manufacture of Cast-iron Pipes," by Mr. T. E. Dimbleby.

Electro-Harmonic Society.—Friday, December 13th. At 8 p.m. Smoking concert at the Holborn Restaurant (Venetian Chamber).

North of England Institute of Mining and Mechanical Engineers.—Saturday, December 14th, at the Wood Memorial Hall, Newcastle-on-Tyne. At 2 p.m. Paper on "The Training of Students in Coal Mining, with Special Reference to the Scheme of the Engineering Training Organisation," by Prof. F. W. Hardwick.

Manchester Association of Engineers.—Saturday, December 14th. At 6.30 p.m. At the Grand Hotel. Paper on "Wood Testing," by Mr. J. E. Hurst.

Birmingham and District Electric Club.—Saturday, December 14th. At the Swan Hotel. At 7 p.m. Annual general meeting.

Industrial Reconstruction Council.—Tuesday, December 17th. At 6 p.m. At the Institute of Journalists, Tudor Street, E.C. Conference on "The Restriction of Output," to be opened by Mr. W. Hill.

Liverpool Engineering Society.—Wednesday, December 18th. At 8 p.m. At the Royal Institution. Paper on "The Growth and Arrangement of Industrial Boiler Plants," by Mr. H. S. Rowe.

Illuminating Engineering Society.—Thursday, December 19th. At 8 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. "Summary of Progress in Photometry, with Special Reference to War Problems."

Chemical Society.—Thursday, December 19th. At Burlington House, Piccadilly, W. At 8 p.m. Paper on "The Conception of the Chemical Element as Enlarged by the Study of Radio-active Change," by Prof. F. Soddy, F.R.S.

Belfast Association of Engineers.—Thursday, December 19th. At 7.45 p.m. At the Municipal Technical Institute. Paper on "Aeroplane Construction," by Capt. G. H. Creighton.

Institution of Electrical Engineers.—Thursday, December 19th. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Paper on "Carbon Brushes: Considered in Relation to the Design and Operation of Electrical Machinery," by Mr. P. Hunter-Brown.

(Irish Centre).—Friday, December 13th. At the Royal College of Science, Dublin. At 7 p.m. Paper on "Heating," by Mr. S. L. R. Price.

(Scottish Centre).—Monday, December 16th. At 7.30 p.m. At 207, Bath Street, Glasgow. Address by the President, Mr. C. H. Wordingham, C.B.E.

(South Midland Centre).—Wednesday, December 18th. At the University, Birmingham. At 7 p.m. Paper on "Carbon Brushes," by Mr. P. Hunter-Brown.

NOTES.

L.C.C. Munition Works.—A report submitted to the L.C.C. Education Committee by the Education Officer with regard to the work done in London educational institutions during the past three and-a-half years in the manufacture of munitions and training of munition workers, states that in June, 1915, the Council agreed to place its resources at the disposal of the Ministry of Munitions and the Metropolitan Munitions Committee. Two lines of action were adopted—(1) the manufacture of such essential munitions as could be made with the staff and machines available in technical institutions, and (2) the training of workers for munition factories. In connection with the manufacture of munitions the main efforts of the organisation have been directed to the manufacture of precision gauges. About 83,000 gauges have been delivered and passed by the National Physical Laboratory; in addition, 65 orders for miscellaneous types of accessories have been completed.

With regard to the second item, over 12,000 students have been in training, of whom about 9,000 have completed their courses satisfactorily and been placed in employment.

The staff engaged on this work at December 1st, 1918, numbered in all 482 persons, 44 of whom belonged to technical institutions, 193 had been transferred from their normal posts in various kinds of schools, and 245 were temporary employés. Machinery and equipment to the amount of £17,000 has been purchased for manufacture, and remains the property of the Council. Certain funds will be available for the reconstitution and equipment of workshops in technical institutions from the manufacturing side. Suggestions have been invited from the various principals and heads of departments who have been engaged on munitions work, with a view to utilising to the best advantage the experience gained during the past three and-a-half years.

The total value of the work carried out for the manufacture of munitions and the training of munition workers has been of the order of £300,000.

The I.M.E.A. and Plant Extensions.—With reference to the memorandum which was addressed to all members of Parliament by the Council of the Incorporated Municipal Electrical Association some weeks ago, suggesting that the Ministry of Munitions had not acted with freedom from partiality in the allocation of sanctions for the extension of generating plant, the following letter, dated December 4th, has been addressed to the Secretary of the Ministry of Munitions of War :—

Sir,—In reply to your letter of November 13th (received on November 15th), the Council of the I.M.E.A., at its meetings held on the 14th and 29th ult., had this matter under further consideration.

A letter dated November 12th has been received from the town clerk, Sheffield, containing the following statement :—

"The Committee desire me to state that the statements made by Mr. Fedden at your meeting of October 17th, to which you refer in your letter to the Ministry of Munitions of the 2nd inst., were made on his own responsibility, and without previous consultation with any members of the City Council, and the Committee, therefore, must disclaim responsibility therefor.

"If it should transpire that any inquiry is made into the allegations on which your Council's resolution is based, Mr. Fedden will be prepared to submit such facts as are within his knowledge, and the Corporation will also furnish any information they may possess."

I am desired to inform you that, having regard to the statements of the Corporation of Sheffield, the resolution of October 22nd is withdrawn, and regret is expressed that the same has been submitted.

A copy of this letter is being sent to everyone to whom the original resolution was communicated.

I am, Sir,
Yours obediently,
(Signed) C. McArthur Butler, *Secretary*.

National Electricity Supply.—In the course of his manifesto, issued last week, the Prime Minister said that one of the most important things the Government had in mind was the utilisation of our great mineral resources for the production of electrical power on a great scale. This would enable rural industries to be created, so that workmen could find remunerative employment under conditions where they could also have a bit of land for cultivation, and where they could bring up their children in the healthier atmosphere of the country. A great electrical power scheme would also assist in cheapening and increasing the efficiency of our town industries.

Australian Electric Supply Advisers.—A Melbourne newspaper, dated September 30th, contains the following paragraph :—"Regulations under the Local Government Act passed by the Executive Council yesterday provide that no person shall act as adviser to an electric supply undertaking unless in possession of a qualification certificate, which may be obtained on application to the local municipal clerk if sufficient evidence is furnished of the applicant's experience."

Electric Precipitation from Flue Gases.—An interesting application of this process was recently made in a copper refinery, according to the *Journal of Electricity*. In this particular installation a noteworthy fact is the size of the generating and transforming unit used, all the current being handled by a single generator and transformer. A duplicate set has been installed for emergency purposes. The tubes containing the high-tension electrodes and through which the flue gases pass are arranged in six groups. The electrodes are suspended at the top from a rack which provides ample insulation, and are connected with the high-tension direct-current line at the bottom. Disconnecting switches permit the current to be cut off from any group to permit inspection and repairs. The gases from the furnaces pass through pipes

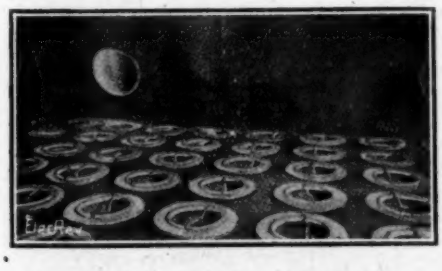

Fig. 1.—Interior of Treater, showing Electrodes suspended in Treater Tubes.

13 ft. in diameter, a "Y" with valves being provided so that the gases can be made to go either through the treater or directly to the stack, as desired. It is stated that tests showed that over 90 per cent. of the fine dust can be removed, and that the value of the copper, zinc, and other metals recovered will within a short time pay for the treating equipment. It is calculated that at full load 0·5 ampere, high-tension, direct-current is needed.

Two 40-K.V.A., 60-cycle, single-phase Westinghouse generators operating at 1,800 R.P.M. are arranged to deliver voltage ranging from 150 to 250 volts. A direct-current power line supplies excitation current. A 50-H.P., 230-volt, direct-current motor drives each generator. The transformers are of 40-K.V.A. capacity, 200 volts low-tension and 100,000 volts high-tension. Additional taps are provided from which voltages of 50, 62½, 75, and 87½ per cent. of the maximum voltage can be obtained, the full capacity of the transformer being available on each tap. The Westinghouse switchboard consists of two panels, one for each generating and transforming set. Each panel carries from top to bottom a circuit-breaker on the line between the generator and transformer, an alternating-current ammeter and voltmeter, a switch to reverse the polarity of the high-voltage direct-current, motor field and line switches, a generator field rheostat, a five-point switch for making connections with the five high-tension taps of the transformer, and the motor starting-rheostat. The voltage of the high-tension direct-current must be varied according to the condition of the flue gases being treated. The transformer taps provide the large steps for this variation and the voltage adjustment of the generator the small steps. In addition a bank of adjustable resistances is connected in series with the low-voltage alternating current, which acts as a ballast and permits of further adjustment of the voltage.

Fatality.—A Leeds boy, aged 10, named David Swift, was killed at the Victoria Council School, on the evening of December 5th. Unasked, he and a friend had been assisting the caretaker in getting some coke into the cellar, and Swift climbed on to the top of the pile and seized hold of the live part of an electric switch, at the same time having hold of an iron pipe near by, which completed the circuit. Another boy ran and turned off another switch, and Swift dropped to the ground dead. At the inquest it was stated that the switch was in proper working order ; but it was strongly recommended that in future the switch-boxes should be kept locked up. A verdict of "Accidental death" was returned.

American Railway Electrification.—The Association of Railway Electrical Engineers was convened for its tenth annual Convention, at Chicago, on October 29th. In the technical programme, the first report presented was that of the Committee on Data and Information, whose function has been to compile statistical data showing the extent to which various kinds of electrical equipment has been adopted by the railroads of the United States and Canada, thereby indicating the general tendencies towards the unification of practice which, in a general way, is the aim of the Association. Accompanying the Committee's report was a detailed tabulation of the various kinds of electrical equipment used at the present time on each of the 66 roads from which reports were received. In addition a tabulation was submitted to show the progress of electric car-lighting and other equipment of the railroads of the country as a whole.

Inquiries.—We are asked whether there is such a thing as an "electric navvy" on the market—apparently an excavator. Such machines have been used abroad, and possibly in this country ; perhaps some of our readers can help us to a reply.

Lantern Slides.—Manufacturing and other firms who have lantern slides showing electrical machinery, oil engines, and other such apparatus are invited to communicate with us, with a view to the utilisation of the slides in a military school of instruction for soldiers about to return to civil life.

Ferro-Concrete Posts.—The Société Mixedstone, of Geneva, erects concrete posts for telegraph and power-transmission lines after the manner of brick pillars. The concrete bricks are supplied ready-made in a thickness of 20 cm. to 30 cm. (9 in. or more) ; each brick is a frame, rectangular or of other shape ; the internal hollow is charged with the cement, in which the iron rods are embedded. Four such bricks are arranged in each layer to make up a four-sided pillar which is built up in sections hollow inside. A telegraph post of this kind, of bricks 25 cm. thick, 25 cm. × 25 cm. at the base, and 20 cm. × 20 cm. in the upper sections, armed with four iron rods, 12 mm. in thickness, one in each brick, was tested last May (*Schweizerische Bauzeitung*, August 24th) by Prof. A. Paris, of Lausanne, in presence of Federal authorities. The post had a height of 6 m. above ground, 1·5 m. being in the earth ; microscopic fissures were noticed during the load test, when the deflection near the top amounted to 76 mm. ; rupture followed 10 minutes after the deflection had risen to 146 mm., the lateral load being 211 kg. per sq. cm., which corresponded to three times the specified strength of 70·5 kg. per sq. cm. Another post for high-tension lines, 8·95 m. high, built up of four columns with 4 × 2 = 8 reinforcement rods, stood a lateral load of 1,600 kg., when the foundation gave way ; the maximum deflection recorded was 50·5 mm. The test proved that these brick-concrete pillars were not inferior to monolithic concrete structures.

What Mr. Hodge Advocates.—In a recent speech, Mr. John Hodge, Minister of Pensions, said that they had got to lay the foundation of a new England. He wanted an eight-hour day for every trade by Act of Parliament, so that the mean employer would not have the opportunity of undercutting the good employer. There could be no mistake as to the fact that there was a section of the community upon whom compulsion must be enforced. There should be minimum wages, minimum hours, and the very best possible conditions of work. National workshops ought to be started for the benefit of the partially-disabled men. The Government ought to schedule all the right jobs in the country suitable particularly for men who had lost an arm or were otherwise impaired. Either that or full pensions should be provided.

Institution and Lecture Notes.—Röntgen Society.—A meeting of the Society was held on Tuesday, last week, at King's College Hospital, Denmark Hill, S.E. Visitors met in the board room at 7.30 p.m, where light refreshments were served, after which there was an inspection of the electrical generating plant. Mr. E. W. Johnston, chief engineer, conducted visitors round the station and explained the details of the plant, including the Siemens automatic telephone exchange which controls over 100 instruments in use. From the generating station current is distributed throughout the hospital, and is utilised for power, lighting, sterilising apparatus in the theatres, &c. The station contains three Diesel engines running on tar oil and direct coupled to E.C.C. direct-current generators running at 200 R.P.M., 110 volts, two sets being rated at 100 KW. and the third at 50 KW. There is also a small battery. The maximum load on the station is about 100 KW., the power load amounting to about 50 KW., which is made up of motors of various sizes driving refrigerators, pumps, lifts, ventilating fans, &c. The evening load on an average reaches about 66 KW. The X-Ray Department was the next visited; in the photographic room there was an exhibition of prints and a portable outfit. Capt. Reed, R.A.M.C., T., gave a practical demonstration of localisation of foreign bodies by means of the Baese localising unit, which apparatus is extremely simple in construction and operation. A foreign body can be localised by means of this unit in about 30 sec. In the radiographic room under Sister Pape various apparatus was inspected, including a large-coil outfit, kidney-examination table with compressor, a McKenzie-Davidson localiser, and a single-impulse apparatus in action. The Sweet method of localising foreign bodies in the orbit and eyeball and the card-index system of filing records were also explained. The dark rooms were next visited, where the reducing lantern and methods of developing were explained. In the consulting room stereoscopic negatives in a Wheatstone stereoscope, a Pèrie stereoscope, and a 50 radiogram in a cabinet were to be seen. Here, also, the storage and examination of negatives is carried out. Next the radio-therapeutic department, under Mr. A. O. Forder, was visited, where a small operating room, diathermy apparatus, both high-frequency and pantostat, together with X-ray treatment cubicles and ultra-violet light apparatus was viewed. Capt. Clayton showed visitors over the electro-therapeutic department, and explained the various forms of treatment used.

Institution of Electrical Engineers (North-Western Centre).—Mr. C. H. Wordingham, C.B.E. (President of the Institution), delivered his address before a meeting of this Centre at Manchester, on Tuesday, December 10th. It dealt with the organisation and work of the Institution, being similar to addresses delivered at other Centres.

Liverpool Engineering Society.—On December 4th, Mr. R. W. Allen, C.B.E., read a paper on "The Air Supply to Boiler Rooms," embodying the results of four years' experiments on the design of intakes, gratings, fans, and fan casings. The data show that very considerable improvements can be effected by having due regard to the behaviour of fluids in motion, and by so shaping the parts in contact with the current of air that eddies may be avoided and stream-line flow obtained.

Electrical Power Engineers' Association.—The Southern Division of the E.P.E.A. has arranged for a smoking concert to be held in Anderton's Hotel, Fleet Street, at 6.30 p.m., on Thursday, the 19th inst. A good programme has been arranged. Tickets may be obtained from the secretaries of Sections, from the organiser, Mr. E. N. Christmas, 55, Calabria Road, N. 5, or at "Anderton's" on the evening of the concert.

At the monthly meeting of the Western Section, Southern Division. E.P.E.A., the following resolution was unanimously agreed to :—

"That the members of the Western Section, Southern Division, Electrical Power Engineers' Association, are of opinion that it is unfortunate that any recommendation for a nominee for the post of general secretary should have been made by the National Executive Council, as their action may have a quite unfair and unwarranted influence ; and they feel that due consideration has not been given to the qualifications which such a position demands. They desire that, so far as is practicable, each member shall be acquainted with the real situation and the vital importance of the appointment before a final decision is arrived at. Further, they take exception to the inadequate salary offered, and suggest that the whole matter be reviewed before nominations are considered. In the opinion of members of the Western Section, it is essential that the future policy of the Association should first be definitely formulated, as the qualifications necessary in a secretary are inevitably linked thereto. They consider that the post should be thrown widely open to competition."

At a meeting of the ABERDEEN ROTARY CLUB on Thursday, last week, Mr. J. A. Bell, the city electrical engineer, read a paper on "Aberdeen Electricity Supply," in which he stated that the power load at Aberdeen had increased by 99 per cent. during the past four years ; the electricity department now supplied 50 per cent. of the power used for industrial purposes within its area.

On November 29th, at the Heriot Watt College, Edinburgh, Mr. A. Thomson read a paper on "The Running and Maintenance of a D.C. Concentric System," before the Lothians Branch of the Association of Mining Electrical Engineers.

Demobilisation and Resettlement : City of London Advisory Committee.—The attention of employers and workpeople is drawn to the activities of the Local Advisory Committee recently set up by the Minister of Labour in connection with the City of London Employment Exchange, 9, New Bridge Street, E.C. 4. In addition to assisting the Exchange in its extensive work of supplying suitable men and women for clerical and professional occupations in the City, the primary functions of the Committee relate to the employment of men now being discharged from H.M. Forces (including questions as to the wages which ought to be paid to disabled men), and also to the arrangements for dealing with reconstruction problems from the labour point of view. The Minister has been fortunate in securing Sir T. Vansittart Bowater, Bart., as chairman of this Committee, together with many prominent citizens—representative of employers and labour organisations—who are intimately acquainted with trade conditions in this area. The Committee has already held several meetings, and there seems every prospect that it will be able to render valuable assistance to the Government in achieving the important objects for which it has been established.

Demobilisation Advisory Committee.—The Minister of Munitions has appointed the following to be an Advisory Committee of Employers to advise upon the Demobilisation Board of the Ministry of Munitions, the Chairman of which is Sir James Stevenson, Bart. :—

Sir Vincent Caillard.	Sir Glynn West.
Sir Allan Smith.	Mr. Henry Summers.
Sir Herbert Rowell.	Mr. E. J. Brown.
Sir Wilfrid Stokes.	Mr. J. Main.
Mr. George Sutton.	Sir Harris Spencer, K.B.E.
Mr. H. C. B. Underdown.	Mr. H. B. Renwick.
Mr. W. L. Hichens.	Mr. R. G. Perry, C.B.E.

Unemployment Pay.—It was announced on Wednesday that the Government had decided to increase the rate of out-of-work donation to men by 5s. per week, making it 29s. ; to women by 5s. per week, making it 25s. ; to boys and girls between 15 and 18, 2s. 6d. per week, making their amounts 14s. 6d. and 12s. 6d. respectively. The new scale is payable as from yesterday, December 12th.

Appointments Vacant.—Outside assistant to take charge of meter, motor, and installation departments for the Leigh (Lancs.) Corporation electricity works ; rolling stock and overhead equipment engineer (£450) for the Belfast Corporation tramways ; chief electrical engineer (£350) for the Colne Corporation electricity works ; shift engineer (£120) for the Llandudno U.D.C. electricity works. See our advertisement pages to-day.

Applications for the Chair of Physics and the Chair of Chemistry at the University of Birmingham, the former held by the late Prof. J. H. Poynting, F.R.S., and the latter vacant by the resignation of Prof. P. F. Frankland, F.R.S., have to be received by the secretary by February 6th, 1919 (the stipend in each case is £1,000 per annum).

Volunteer Notes.—ROYAL ENGINEERS (VOLS.), LONDON ARMY TROOPS COMPANIES.—Headquarters : Balderton Street, Oxford Street, W. 1.

Regimental Orders No. 50, by Lieut.-Colonel C. B. Clay, V.D., Commanding. Monday, December 16th, to Saturday, December 21st.—Drills as usual.

C. HIGGINS, *Capt.* R.E., *Adjutant.*

The Eight-Hour Day.—According to the *Manchester Daily Dispatch*, Mr. J. Rowan, general secretary of the Electrical Trades Union, in a special circular, says :—"We have been in direct negotiations for a shorter working week since 1913. The negotiations were suspended in 1914 on account of the war, and reintroduced two months ago. It must be borne in mind, however, that the desire for a 48 hours' week has been in the minds of the trade for at least 40 years. American organised labour, as one of their conditions for giving their support to the United States entering the war, laid it down that a 48 hours' week would be established in the United States at the end of the war. German workmen, when forming a new Government, also laid it down that one of the points must be a 48 hours' week. French labour has made similar proposals. From this, it will be seen, the movement is world-wide."

The following reasons are given for the demand for a 44-hour working week for Manchester Corporation employés :—

1. The Government's strong recommendation for easing the strenuous hours of labour.
2. A reported decision by Government inquiry of a higher standard of health prevailing as a direct result of breakfasting before work.
3. The expressed desire of municipal workers to attend evening technical classes, in order to qualify for a higher standard of efficiency in productive capacity, this being inconsistent and inopportune with early rising.
4. To afford a strong opportunity of absorbing surplus labour of discharged soldiers (who deserve the highest consideration) now returning to civil life.
5. To carry out in actual fact the strong recommendations as advised by our Premier at the Hippodrome on the occasion of the presentation of the Freedom of the Borough, September 12th, 1918.

Drake & Gorham, Ltd.—Mr. and Mrs. Bernard Drake entertained the heads of departments of the London offices of Messrs. Drake & Gorham, Ltd., at luncheon on Thursday, December 5th. Mr. Drake expressed his appreciation of the way in which the staff had worked during the war, and alluded to the various war contracts which the firm had carried out to the satisfaction of the departments concerned. These included equipments for the manufacture of explosives, poison gases, anti-submarine apparatus, and power and lighting plants for camps, aerodromes, and other military establishments. From the firm 123 had gone into khaki, two had been killed, and several wounded. He had seen it stated that every man in the fighting line required the work of nine others to keep him there. He thought those who were concerned in what might be termed the drudgery of war production had in many respects a more trying time. Mr. R. Wilson Smith proposed a vote of thanks to the chairman, who, he said, had worked as hard as anybody during the war, and to Mrs. Drake for the personal interest she had always displayed towards individual members of the staff.

Accident.—James Johnston, assistant in the employment of the Electric Lighting Co., Newcastle, Co. Down, had a miraculous escape from being mangled in the machinery on Friday evening last week. The boy was assisting in starting the engine by pulling on the belt when the engine suddenly back-fired. Johnston failed to release his hold, and he was drawn under the fly-wheel, and so tightly wedged in that it necessitated the dismantling of the engine before he could be extricated. Johnston's wounds were slight, but he is still suffering from shock.

Light-Weight Motors.—We understand that the Royal Aircraft Factory has succeeded in evolving a motor of 500-watts capacity, which weighs only 12 lb.

Educational.—Northampton Polytechnic Institute.—The prize distribution took place on Saturday last, when the Principal, Dr. R. Mullineux Walmsley, read his report on the past year's work. He stated that, as regarded the Engineering Day College, the manufacture of high-class munitions upon a commercial scale commenced on July 1st, 1915, was continued uninterruptedly during the whole session, and until last week. During its existence this workshop has produced 14,720 high-precision gauges, many of them accurate to two ten-thousandths of an inch, and 43,511 gun parts for Woolwich Arsenal, a record which is believed to be in excess of the record of any similar educational workshop in the metropolis. In the Technical Optics Department the work of training women students in full-time classes in lens and prism grinding was vigorously carried on throughout the whole year, with the result that an almost continuous stream of women-workers in the industry was available for the development and extension of existing optical workshops, not only in England, but also in Scotland and Ireland. During the session nine complete courses for training suitable men as electrical sub-station attendants were held, and the whole of the men trained were placed out. This brought the total number of such courses held, since they were started in June, 1916, to 20. The Roll of Honour showed a total of 2,052 individuals who had joined the Colours, including 65 members of the staff, 712 members and students and 1,275 students. In addition, there were a number of V.A.D.'s serving in military hospitals abroad and at home. Ninety have given their lives in the service of their country, and 190 have been wounded in that service. The Roll of Distinction contains 42 names. The equipment and staff of the Polytechnic have been at the disposal of the Government for experimental and scientific work intended to aid the prosecution of the war, and, as the equipment of the laboratories is very complete, a considerable amount of excellent work has been done.

University of London, University College.—Arrangements have now been completed in the Faculty of Engineering to enable students, whose courses have been interrupted by war service, to resume them as nearly as possible at the point at which they left off, by rejoining at the beginning of the second term, January 13th, 1919; and to enable students who were unable to begin their engineering studies last October, owing to war conditions, to begin them by entering next term, January 13th, 1919. For both classes of students additional work will be provided during parts of the Easter and Long Vacations, so as to enable them to get in a full session's work between January and August, 1919.

NATIONAL ELECTRICITY SUPPLY.

The Incorporated Municipal Electrical Association has been considering the report of the Committee appointed by the Board of Trade on the subject of Electric Power Supply, and at a general meeting of the members at Birmingham, on November 29th, adopted a report addressed to the Rt. Hon. Sir Albert H. Stanley, M.P., President of the Board of Trade. An abstract of the report is given below:—

After giving a summary of the chief recommendations contained in the report of the Board of Trade Committee, the report proceeds:—We observe with satisfaction that the report recommends that in the national interest generating stations and main transmission lines ought, as a general rule, to be publicly owned, and submit that the District Electricity Boards should in all cases be so constituted as to be wholly independent of the influence or control of commercially-owned electrical enterprises. To secure this object, it is strongly urged that the Boards should consist of representatives of local authorities and large consumers, to the exclusion of companies generating or distributing electricity.

The suggested methods of electing the Boards are open to criticism in detail; in the constitution of the Boards a combination of all the public interests concerned would lead to efficient and economical administration. Those representatives who are at present primarily responsible for the administration of the existing publicly-owned undertakings, such as chairmen and deputy-chairmen of municipal committees, would be suitable to form the nucleus of the new Boards, in view of their special local knowledge, and this course would ensure a continued expansion of the business on lines suited to the needs of their local areas. Members of the Board should be elected for a period of six years.

Clause 30 appears to suggest that three of the five Commissioners should give their whole time to the service at a salary not less than £3,000 a year, and that the other two may be remunerated in some other way, and be allowed to engage in other work. If this interpretation of the Committee's intention is correct, we emphatically protest against the proposal, as we believe it essential that all the Commissioners should be whole-time officers, and have no other interests whatever than the special duties which it is proposed to confer upon them.

Ample evidence is available to demonstrate the fact that a well-situated power station, equipped with large modern units of generating plant, is able to afford a supply of electricity at the station bus-bars at a lower price than a number of separate stations of a total equivalent capacity. The question of a cheap supply of electricity is not, however, solely dependent upon cheap generation. In certain cases the capital costs and operating expenses incidental to a long transmission line may counter-balance the advantage derived from the concentration of large plants. But in most industrial districts these large stations will be connected together by means of a common network, which should result in a considerable saving in capital expenditure on spare plant. They are also thereby enabled to operate at a higher load factor, and to obtain the great advantage of still lower working costs which result from a diversity of demands.

A mistaken impression undoubtedly exists that the report recommends the establishment of 16 large power stations for the supply of the whole of the electrical requirements of the country. The number 16 refers not to power stations, but to the number of districts into which the country would be divided for administrative purposes. It may be possible to have an area too large for efficient administration and control. Attention is drawn to the great amount of work already done in several parts of the country towards the delimitation of suitable areas. Full opportunity should be afforded the several local undertakings to make representations to the Electricity Commissioners on this point.

We agree with the findings of the Committee in regard to the transfer of all generating stations and main transmission lines to the Board, subject to the reservations herein stated. Such a procedure we consider absolutely essential in all cases where energy is to be transmitted from one area to another by means of an interconnected network, or where extensions of plant are carried out for the common use of the authorities constituting the Board. We are of opinion that to allow any existing undertaker to retain the ownership of a power station within any given district, whilst the remaining power stations are transferred to the Board, would introduce serious complications in actual practice, as well as financial chaos, and is therefore quite impracticable. When local undertakings are transferred to a District Board, provision must be made to transfer all the rights and obligations under existing contracts. The provisions made for excepting certain undertakings from transfer to the District Boards cover all the cases likely to arise in practice.

The report nowhere countenances the view held in some quarters that all existing power stations are to be shut down, and new super-power stations erected forthwith. The first duty of the District Boards will be to consider which stations, or portions of stations, should for the time being be employed; then to consider on which of the existing sites extensions can be economically carried out, and if and when these provisions are found inadequate to deal with the requirements of the area, the question of new sites, with large modern plants, would then be considered. Under this procedure some stations will be shut down, others will be continued, and a few will be extended.

The report clearly contemplates—and, in our opinion, rightly so—that with the exceptions already referred to, all extensions should be financed by the new District Boards. A consideration of this point will inevitably lead to the conclusion that all generating stations should be transferred to the new Boards.

Paragraph 56 (*c*) of the report contains a most important provision, namely, that it should be obligatory for the District Boards to supply a local undertaking, whose generating plant has been taken over, at least as cheaply as the latter could produce it themselves. We are of opinion that this safeguard should go a long way to facilitate the shutting-down of uneconomical plants.

We favour direct control and operation by the several District Electricity Boards in their respective areas.

We are in general agreement with the recommendation that existing authorised undertakers should retain their distributing rights.

We are strongly of opinion that the terms set out in paragraph 56 (*b*) of the report, upon which the several undertakings should be transferred to the District Boards, are inequitable and inadequate, and are not such as could be accepted by local authorities. Where the District Board is formed to take over the undertakings of local authorities only, the basis of outstanding debt might not be inappropriate. We are of opinion that all sums—to whatever fund they may be allocated—other than statutory sinking funds, should be retained by the individual undertakings.

The case of those authorities who have placed sums from revenue account to capital account, or who, whilst maintaining their undertakings in a high state of efficiency out of revenue, have written down their capital at a rate in excess of statutory requirement, should receive special consideration.

The difficulty is greatly accentuated in the case of the companies, or where both local authority and company under-

takings have to be acquired by a District Board. Obviously, equality of treatment is essential, and in such cases it may be found necessary to apply Section 2 of the Electric Lighting Act, 1888.

The transfer of local authority undertakings to the new District Boards should not be viewed in the light of a public purchase, but more on the lines of the setting up of a partnership.

In Clause 70 it is suggested that provision should be made whereby the District Board *may* provide compensation for displaced engineers and officials in case of hardship. We do not consider these provisions are adequate. In all cases where a power station or distributing system is transferred, thereby involving a loss to or diminution in the position of officials, a definite obligation should be placed upon the District Board to provide compensation on a fair and reasonable scale, which scale should be set out in any Bill that may be promoted to carry into effect the recommendations of the report.

With regard to the use of overhead lines, wayleaves, rating, water rights, and liability for nuisance, amendments to the existing law in these directions are considerably overdue, and it will be difficult, if not impossible, to develop a national scheme until largely extended powers are granted in these directions.

We entirely support the findings of the Committee that the present position is unsatisfactory, contrary to the national interests, wasteful of fuel resources, and deprives industry of the advantages which would result from a well-devised system of generation and transmission. In most districts the position of undertakings in regard to the provision of extensions to meet future requirements is of the most pressing importance. In order that steps may be taken at the earliest possible date to proceed with developments on sound lines, we are of opinion that the Commissioners should at once be appointed to assist in the preparation of the legislation necessary to give effect to the recommendations contained in the Board of Trade Committee's report.

Regarding the enhanced cost of materials resulting from the war, we heartily support the recommendation that assistance, both financial and otherwise, should be given by the Government in order to ensure the early carrying out of extensions without unduly burdening the industry with high charges for interest and amortisation. The suggestion that the sinking fund should be suspended, and interest paid out of capital during the constructional period, should receive support.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station and Tramway Officials.—Mr. H. W. FIDDAMENT, of the Manchester Corporation tramways department, and previously with Messrs. Dick, Kerr & Co., has been appointed car shed superintendent to the Exeter Corporation Tramways at a salary of £239 per annum.

Birkenhead Electricity Committee has appointed Mr. W. C. GALLOWAY, of the borough treasurer's department, chief clerk in the electrical engineer's department at £200 per annum, plus war bonus.

General.—Coun. J. THOMPSON has been appointed chairman of the Wolverhampton Electricity Committee.

Roll of Honour.—Lieutenant C. F. BARROW, R.E., who has been awarded the Military Cross, was employed in the Bolton Corporation electricity works.

Sapper S. H. BURROWS, who has died of wounds, was an apprentice with Messrs. Electromotors, Ltd., Manchester.

Private L. WHEELER, M.T., A.S.C., who has died of illness in Mesopotamia, was an apprentice with a Bedford firm of electrical engineers.

Captain T. HOLDER, London Scottish, who has died in hospital at Banbury, was previously engaged with a London electrical engineering firm. He was in the Mons retreat, and was given his commission on the field.

Mr. S. S. BARBER, one of the prisoners of war released from Ruhleben, is an electrical engineer, and he was formerly on the staff of Messrs. Siemens Bros., of London. At the outbreak of war he held an appointment in Germany.

Mr. E. N. PINK, who has arrived at his home at Winchester, after being a prisoner of war at the Ruhleben camp, Germany, for four years, was previously an electrical engineer at Berlin.

Corporal G. CRANFIELD, M.T., A.S.C., who has died from the effects of a chill, was an electrical marine engineer, formerly with Messrs. Cammell, Laird & Co., Ltd., of Birkenhead.

Obituary.—MR. A. A. MILLS.—The death occurred recently of Mr. Alfred A. Mills, aged 58 years, who was for a long period on the staff at the Limehouse generating station of the Stepney Municipal Electricity Works.

Will.—Mr. JAMES ARTHUR FRY, who left £500,000, "so far as can be at present ascertained," was a director of the Bristol Wagon and Carriage Works, Co., Ltd.

NEW COMPANIES REGISTERED.

Explosives Trades, Ltd.—This new company has been registered at Somerset House by Ashurst, Morris, Crisp & Co., Solicitors, 17, Throgmorton Avenue, E.C., with a nominal capital of £18,000,000 in £1 shares (6,500,000 6 per cent. cum. pref., 8,000,000 ord., 1,500,000 def., and 2,000,000 to be issued with such rights as the directors may think fit, subject to the rights of the cum. pref. shareholders). The objects are: To carry on the business of manufacturers and producers of explosives of all kinds, chemicals, artificial manures, dyes, &c., and to enter into an agreement with the Lords Commissioners of H.M. Treasury and the Rt. Hon. Sir Albert Stanley. The Articles of Association contain provisions (in the usual form approved by the Board of Trade) for excluding foreign control. The filed documents do not give a list of amalgamating firms, but a circular recently sent out by Nobel's Explosives, Ltd., states that the boards of some 29 well-known companies have approved the scheme. The directors are to number not less than five nor more than 21. No enemy may be a director or alternate director, and at least three-fourths of the directors must always be British subjects resident in the United Kingdom. The qualification of a director is ordinary and/or deferred shares of the nominal value of £2,000. Remuneration, £1,000 per annum for the chairman, £750 for the deputy-chairman (if any), and £500 each for the others. No notice of situation of registered office was filed with the original papers. The registration fees paid to the Government in connection with the above registration amount to over £45,000.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Hong-Kong Tramway Co., Ltd.—Satisfaction to the extent of £300 on May 14th, 1918, of mortgage by way of trust deed, dated July 1st, 1903, securing £195,000. (Notice filed November 27th, 1918.)

Power Plant Co., Ltd.—Satisfaction in full on October 8th, 1917, of debentures dated 1906-13, securing £5,000, £2,000, and £5,000.

James Keith & Blackman Co., Ltd.—Satisfaction in full on November 11th, 1918, of first and second debentures, dated 1902-14, securing £800.

Holloway Electric Supply Co., Ltd.—Mortgage and land registry charge on freehold property at Islington, dated November 9th, 1918, to secure £1,600. Holders: Mrs. A. C. Mackower and E. Wheldon.

Remco Carbon Co., Ltd.—Particulars of £2,500 debentures created October 7th, 1918, filed, the whole amount being issued on November 29th, 1918. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

CITY NOTES.

Fuller Accumulator Co., Ltd.

Mr. G. Fuller, M.I.E.E., presiding at annual meeting on December 3rd, said that they were still unable to give a detailed statement of their finances owing to long negotiations that had been going on under the Excess Profits Acts. In the meantime they felt justified in recommending dividends of 10 per cent. on the preference and 15 per cent. on the ordinary shares. The turnover for the past three years had been approximately: 1916, £50,000; 1917, £150,000; 1918, £280,000. As to reserves, they had written £18,000 off patents, approximately £16,000 off buildings, machinery and plant, and after setting aside an ample sum for excess profits and munitions levy, they were carrying forward a substantial amount. Generally speaking, the profits had increased in a similar rate to the turnover. The buildings and plant had been greatly extended, and with a view to the future development of the company they had purchased considerable additional land adjoining the works. Their site was one of the finest for electrical works, with ample provision for future extensions. They commenced the new year with the greatest hopefulness. The directors were optimistic men of business, full of enterprise, and alive to all the great possibilities. The prospects of electrical requirements in the future were so great as to be almost overwhelming. At the close of the financial year the orders on the books were over £110,000. Accumulators would be more and more necessary in the future development of the electrical trade. They were really a key industry, and the company's field of enterprise was world-wide. Another important development in their business was the manufacture of electrical miners' lamps using their block cell. They had orders on the books for many thousands of these lamps. They anticipated being very busy in the near future in supplying the greater part of the requirements of the mining industry. The chairman referred in some detail to the social side of the business, and the arrangements that were made to improve the conditions of the workpeople.

In the course of a reply to questions, the chairman said that they were not dividing the profits up to the hilt; they could have doubled the dividend on the ordinary shares quite easily, but deemed it more prudent to keep as large a sum as possible in hand in view of the expansion of the business. The question of additional capital would have to be considered shortly, and the shareholders would have the first opportunity of subscribing.

Tata Hydro-Electric Supply Co.

The ninth ordinary general meeting of the shareholders was held on October 24th at Bombay, Sir D. J. Tata, Kt., chairman of the board of directors, presiding. The report for the year ended June 30th, 1918, showed that the company's total income was Rs.32,28,162; deducting total expenditure of Rs.13,49,384 and Rs.4,00,000 set apart for depreciation, the balance was Rs.14,78,777. Adding Rs.75,340 brought forward from last account, and Rs.6,91,484 which stood in last account for premium on shares, and which has now been transferred to profit and loss account, the total disposable profits amounted to Rs.22,45,602. Deducting Rs.8,01,247 paid in May last by way of ad. interim dividend and two sums of Rs.3,98,155 and Rs.49,362 respectively, representing part of guarantors' commission and balance of brokers' commission, and also Rs.80,613 carried to reserve fund, the balance available for distribution was Rs.9,16,235. Payment was recommended of the final dividend for the year at 7 per cent., less income tax, on preference shares, and at 8 per cent. on ordinary shares, old and new, with due regard to the amount paid up per share. That would absorb Rs.8,35,067, leaving Rs.81,167 to be carried to the next account. The present B.H.P. of motors in service is 45,000, exclusive of 5,500 H.P. supplied to consumers other than factories. The plant at the power house has on the whole given satisfaction; improvement in the generators has been undertaken with good results. Lightning storms have this year given rise to more frequent interruptions to service, and special steps are being taken to further strengthen the lines. The fourth synchronous condenser has been erected and put into service, and all the plant has continued to give satisfactory service. No trouble has been experienced with the underground cable system. Forty-one consumers are now receiving power. Difficulties in getting the necessary equipment consequent on the continuation of the war have prevented completing the installation of equipments for power already contracted for. The operation of the hydraulic lakes and canals system has been taken over by the operating staff. During last season good progress was made with Shirawta dam. The chairman in his speech said that the number of consumers had again increased from 38 to 41; the increase would have been still greater but for the war, which had delayed the supply of mill motors and cables. They had been rather severely and unexpectedly handicapped by the extraordinary paucity of the rainfall. The minimum rainfall for the last 50 years for which they had records was 93 inches. For the year under review it had only reached 88 inches. With the various steps taken, and some luck in the unseasonable rains, they would probably tide over what appeared to be a rather difficult situation. They had to congratulate themselves on the growing popularity of electricity as a motive power in that city. They had already a large night load; the public and the Government had been rendered a great service by the conservation of coal; the energy supplied by them during the last year would have required 100,000 tons of coal to produce it and 6,000 wagons to bring that amount of coal into Bombay. Their income was increasing, and he felt confident of the future.

India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.—The report for the year ended September 30th, 1918, states that after making provision for doubtful debts and war contingencies reserve, which includes excess profits duty and munitions Exchequer payments, the net profit is £143,589, plus £59,866 brought forward. The preference dividend absorbed £12,500; interim dividend on the ordinary shares £12,500; put to reserve £50,000. A final dividend of 15s. per share, free of income tax, making 10 per cent. for the year, is recommended, requiring £37,000, and leaves £90,955 to be carried forward. Mr. G. W. Smith, extraordinary director, who had been manager of the Persan factory for 44 years, died in February last. Mr. Stuart A. Russell, the works manager at Silvertown, has been elected an extraordinary director. Meeting, December 19th.

Barbados Electric Supply Corporation, Ltd.—Trading profit for the year ended June, 1918, £3,197, against £2,970 and £2,693 for the two preceding years. Repairs and renewals, £484, consist chiefly of replacing poles, which work is now practically completed. Consumers increased from 1,403 to 1,541, and 25-C.P. (equiv.) connections from 19,562 to 22,208. Considering the continued difficulty of obtaining materials the progress is satisfactory. £1,270 was expended on further house connections and additions to mains. Owing to legal difficulties in connection with the collateral security proposed to be issued on the renewal of the loan of £10,000, an arrangement has been made with the subscribers to that loan under which they have taken up £110 of 5½ per cent. debentures in respect of each £100 subscribed.

Castner-Kellner Alkali Co., Ltd.—Net profit £261,339, plus £45,078 brought forward. £60,000 is put to depreciation, a final dividend of 11 per cent. is to be paid, making 20 per cent. for the year, and £48,819 is to be carried forward.

Parsons Marine Steam Turbine Patents, Ltd.—Dividend for 1917-18 25 per cent., the same as for each of the two previous years.

Amazon Telegraph Co., Ltd.—Mr. C. W. Parish, speaking at the annual meeting on November 26th, said that the difficulties prevailing in the Amazon had necessitated the sending of a large number of telegrams. Their traffic receipts had amounted to £59,158, as compared with £51,166 for the previous year, an increase of £7,992, or over 15 per cent. The Brazilian Government subsidy and interest were both slightly higher, and the gross revenue amounted to £80,455, against £72,144, an increase of £8,311. Whilst most of the expenditure items showed a slight increase, the cost of maintaining cables had amounted to only £12,476, or £2,409 less than for the previous year. The total working expenses were £31,598, or under 40 per cent. of the gross revenue. The net revenue was £48,857, as against £40,605, an increase of £6,252, or over 20 per cent. After placing £17,000 to the general reserve account, increasing it to £65,000, they recommended a dividend of 4½ per cent., less income tax, leaving £6,842 to be carried forward. With regard to prospects, traffic receipts up to date were about the same as for the corresponding period of last year. It was impossible to foretell what conditions were likely to prevail in the rubber market during the remainder of the year, but it was the general opinion that when peace was settled and normal shipping facilities were available, there would be a great demand for rubber; if so, it would bring additional revenue to the company. They might safely face the remainder of the year with equanimity. The expectation of a further expansion in the service of local deferred messages had been justified, as 107,262 more local deferred words had been sent during the year, an increase of 133 per cent., and the receipts from that class of traffic were £5,459 more than in the previous year. Mr. F. E. Nosworthy (the managing director) said that their system now comprised 2,480 nautical miles of cables, with 19 stations. During the last two years there had only been six interruptions to through communication, totulling 17 days.

Cape Electric Tramways, Ltd.—Mr. L. Breitmeyer, presiding at the annual meeting on November 27th, said that the recovery in the traffic receipts had steadily continued, and was the most satisfactory feature of the undertaking. During the year the passengers carried on the Cape Town and Port Elizabeth systems were 26,444,465, earning £264,138, an increase of 2,692,449 passengers and £33,032. The nearest approach to these figures was in the year 1903-04. The working expenses were higher than in the preceding year, but the ratio of expenses to receipts at 61.16 per cent. compared with 60.91 per cent. in the preceding year. The profits earned were better by £8,420. Most of their fares were fixed either by Acts of Parliament or by agreements, and the power of revision was considerably restricted, but they had put increases into force where they were free to do so, though those alterations were only introduced toward the end of the financial year. South Africa, from the business and agricultural points of view, had been passing through a period of unprecedented prosperity. New industries had been started. Work was in full swing, and at high pressure everywhere.

Norwegian Marconi Company.—It is announced from Christiania that the "Norsk Marconi Kompagni" has been floated, with a capital of 900,000 kroner, which will engage in the construction and sale of apparatus for wireless telegraphy and telephony. The Marconi Wireless Telegraph Co., London, is to receive 300 shares in return for the exclusive right granted to the Norwegian company to construct and sell apparatus in accordance with the patent of the English company. As the Belgian "Société Anonyme Internationale de Télégraphie Sans Fil," which is closely connected with the English company, had previously received the sole right for the sale and erection of wireless installations on board Scandinavian merchant ships, the Norwegian company has concluded an agreement with the Belgian company, according to which the former obtains the right of having the monopoly of supplying all Norwegian merchant ships, which will be built in Norway, with Marconi wireless installations. —*Financier.*

Fraser & Chalmers, Ltd.—In their report to June 30th the directors refer to the sale of the Erith works and the engineering business to the General Electric Co., Ltd. The price agreed, which included a substantial sum for goodwill, in addition to the book value of buildings, plant, machinery, and stocks, has been received in cash since the close of the accounts. The assets of the business in South Africa have also been sold. The profit, after providing for depreciation, and after making provision for excess profits duty, was £33,295, as compared with £36,174 for the previous year. Negotiations are proceeding with regard to the sale of the assets of the remaining branches of the company in Canada, Australia, and Singapore. In view of the comprehensive realisations which have been lately effected, the directors will ascertain the views of the shareholders at the coming meeting with regard to liquidation.

Companies Struck Off the Register.—The following companies have been struck off the Register, and are accordingly dissolved:—

Anglo-Foreign Engineering Offices, Ltd.
Harold Wood Electrical & Engineering Supplies Co., Ltd.
Stansfield Engineering Co., Ltd.

Power Gas Corporation, Ltd.—Satisfactory results for the year. An agreement has been entered into for the purchase of Messrs. Lymn & Rambush, thus securing a new type of gas-producer plant. Profit £26,899, plus £10,525 brought forward. Dividend 6 per cent., less tax; £5,350 to reserve, and £16,797 carried forward.

Western Telegraph Co., Ltd.—First quarterly interim dividend 3s. per share, free of income tax, being 6 per cent. per annum.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—Final dividend of 3 per cent. on the 6 per cent. cum. pref. shares.

Globe Telegraph & Trust Co., Ltd.—Quarterly dividend 2s. per share on ordinary shares.

Shawinigan Water & Power Co.—Dividend of 1¾ per cent., less tax, for the quarter.

STOCKS AND SHARES.

Tuesday Evening.

The main interest of the week is that centred upon Home Railway stocks. In this market, the recent speech of Mr. Winston Churchill at Dundee, at which he said that nationalisation forms part of the Government programme, has awakened interest in a lively degree, and has had the effect of putting up prices smartly. Optimism is rife with regard to the prices which holders of the stocks are likely to receive under a nationalisation scheme. Some quotations have gone up 4 or 5 points. Others advanced more slowly. Amongst the latter may be classed Districts and Metropolitans, with gains of ¼ and 2 respectively. The Income Bonds of the Underground Electric Railways, after touching 92½, went back to 91½, showing a rise of 2. Upon what basis the Government is likely to found its scheme for taking over the securities is, of course, entirely unknown. Ingenious calculations are made to show that the basis is likely to be one which will give proprietors considerably more money than their stocks are valued at in the market to-day.

Manifestly, Home Railway dividend-paying securities will have to be treated in a class different from that which governs the non-dividend payers, and on any probable ground, so far as can be seen at present, Metropolitan Consolidated stands fairly high. In regard to Districts, the fact of the stock having received no dividend for 36 years is accounted as a point in its favour. What is likely to happen to the Debentures, Guaranteed and Preference issues few people care to hazard a guess. It is, however, interesting to notice that City & South London 4 per cent. debenture stock can be bought at 70, giving a return on the money of 5¾ per cent. In the preference list, District 4½ per cent. is on offer at 71½, the return in this case being 6¼ per cent., while London Electric 4 per cent. preference is offering at 65, affording a return of 6¼ per cent. on the money. A small amount of District 3 per cent. rent charge can be obtained at 54, the yield in this case coming to £5 13s. 3d. per cent. None of these stocks are, of course, available for strict trusts, and consequently they show higher yields than can be obtained from investment securities falling within the trustee boundary.

Accompanying the rise in prices has come a considerable volume of business, so that the market presents an aspect of greater activity than has characterised it throughout the present year. The introduction of an eight-hours day is held to be of no particular account in reckoning up the chances of valuation under a nationalisation scheme, and it is considered that it will pay the companies to declare as much dividend as they possibly can in respect of the current six months, since thereby they may be improving their chances of obtaining a good price for the stocks when the blessed word "nationalisation" is translated into practical politics.

Elsewhere in the Stock Exchange markets there is a fair amount of activity amongst industrials. British Aluminiums have been prominent with a rise to 37s. Dealings have now started in the new shares of Callender's Cable, and the ordinary are quoted at £7¼ for the £5 ordinary shares, while the preference stand about ¼ above the paid-up value of £3. Allotments of the new Siemens shares have appeared within the past few days, and the market price is 5¾ middle, comparing with 6¼ for the senior issue. Babcock & Wilcox have fallen ¼. The Fraser & Chalmers report had little influence upon the price of the shares, which remained at 31s. 6d. Indeed, some disappointment is expressed at the lack of information with regard to the assets of the company in Singapore, Canada, and Australia, although those in the Union of South Africa duly figure in the balance-sheet. Analysis of the latter is held to show that the current quotation represents a fair value for the shares, but having regard to the other assets already mentioned, the optimists look for an ultimate price several shillings higher than that now prevailing.

Electricity supply shares are mostly quiet. The advanced levels are well maintained, but pending further developments there is not much going on at present. Brompton ordinary and Chelseas are both ¼ up, while Kensingtons show a rise of 7s. 6d., advancing to 5¼. South Metropolitan second preference at 18s. are a shilling to the good.

Beyond a further sagging in the price of Anglo-American Telegraph deferred to 23¼, and another 1/16 improvement in United River Plate Telephones, the list of cable issues exhibits no changes. India-Rubber shares have risen 5s. to 17¾ in spite of the slight falling-off in profits as disclosed by the report just out. The dividend on the ordinary shares is again 10 per cent., free of tax. The directors raise the carry-forward by some £30,000 to £90,000, and the balance-sheet shows the company to be in an excellent position.

The colonial and foreign traction group is disposed to ease off, except as regards debenture stocks of the best companies. Amongst the latter, Madras 5 per cent. debenture stock has risen 3 to 85, and Melbourne consolidated debenture stock at 86 is 1 up. On the other hand, British Columbia Electric debenture moved back a point, and Brazilian Tractions are 1½ lower, while the Anglo-Argentine Tramways group is inclined to give way a trifle after its recent display of strength. Pernambuco Trams are fairly active about 8s. 3d., but business in the preference has dwindled, and the price is now 16s. 9d. An inquiry for Isle of Thanet 5 per cent. preference, no dividend on which has been paid since December, 1913, showed a pronounced scarcity of shares, while it is not easy to buy the ordinary at anything like their normal quotation of half-a-crown. London & Suburban ordinary at 3s. 6d., and the preference at 8s. 6d. are more easily dealt in. British Electric Traction remains firm at 47½, and the 6 per cent. preference at 78½. The Rubber market shows very little change on the week, and business in base-metal shares is meagre.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1916.	Dividend 1917.	Price Dec. 10, 1918.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	9	10	7½	+ ¼	£6 18 0
Charing Cross Ordinary	5	4	3½	—	5 14 4
do. do. do. 4½ Pref.	4½	4½	3⅝	—	6 13 4
Chelsea	3	5	4	+ ¼	6 5 0
City of London	8	8	13½	—	6 0 9
do. do. 6 per cent. Pref.	6	6	10½	—	5 18 5
County of London	7	7	11½	—	6 5 7
do. do. 6 per cent. Pref.	6	6	10½	—	5 18 5
Kensington Ordinary	6	7	5¼	+ ¼	5 19 2
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	4	5	4	—	6 5 0
Metropolitan	3	4	3½	—	6 3 1
do. 4½ per cent. Pref.	4½	4½	3½	—	6 18 6
St. James' and Pall Mall	8	9	7½	—	6 6 4
South London	5	5	3	—	6 13 4
South Metropolitan Pref.	7	7	20/6	—	6 16 7
Westminster Ordinary	7	9	7½	—	6 6 4
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	90	—	6 1 0
do. Def.	1½	1½	23⅝	— ⅛	6 9 6
Chile Telephone	8	8	70	—	5 6 8
Cuba Sub. Ord.	7	7	103	—	*6 13 4
Eastern Extension	8	8	152	—	*5 1 7
Eastern Tel. Ord.	8	8	159½	—	*5 0 5
Globe Tel. and T. Ord.	7	7	144	—	*4 16 5
do. do. Pref.	6	6	104	—	5 14 3
Great Northern Tel.	24	22	82	—	6 13 5
Indo-European	13	13	58½	—	5 11 0
Marconi	15	20	4⅝	—	4 6 7
Oriental Telephone Ord.	10	10	90	—	2 17 2
United R. Plate Tel.	8	8	7⅞	+ 1/16	*5 3 3
West India and Panama	6d.	1/3	11½	—	*3 12 6
Western Telegraph	8	8	102	—	*4 15 7
Home Rails.					
Central London Ord. Assented	4	4	65½	—	6 2 2
Metropolitan	—	1	31	+ 2	3 4 6
do. District	Nil	Nil	26	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	8⅜	— ⅛	Nil
do. do. "A"	Nil	Nil	9/-	—	Nil
do. do. Income	6	4	91½	+2	*4 7 5
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	42	—	6 6 4
Anglo-Arg. Trams. First Pref.	5½	5½	4⅝	+	—
do. do. 2nd Pref.	5½	—	3⅜	—	—
do. do. 5 Deb.	5	5	75½	—1	6 12 5
Brazil Tractions	—	—	50	— 1½	—
Bombay Electric Pref.	6	6	102	—	5 11 7
British Columbia Elec. Rly. Pfce.	5	5	67½	—	7 11 5
do. do. Preferred	Nil	Nil	52½	—	Nil
do. do. Deferred	Nil	Nil	47½	—	Nil
do. do. Deb.	4½	4½	62	—1	6 17 9
Mexico Trams 5 per cent. Bonds	Nil	Nil	67	—	Nil
do. 6 per cent. Bonds	Nil	Nil	55	—	Nil
Mexican Light Common	Nil	Nil	40	—	Nil
do. Pref.	Nil	Nil	50	—	Nil
do. 1st Bonds	Nil	Nil	71	—1	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	32	— ¼	4 9 0
British Aluminium Ord.	10	10	37/-	+ 2/-	5 8 1
British Insulated Ord.	20	20	2½	—	4 9 0
British Westinghouse Pref.	7½	7½	33	— ½	5 14 1
Callenders	20	25	9⅜	—	6 9 10
do. 5 Pref.	5	5	5¼	—	—
Castner-Kellner	22	20	33	—	5 10 4
Edison-Swan, "A"	—	—	¾	—	Nil
do. do. 4 per cent. Deb.	4	4	75½	—	5 6 0
Electric Construction	7½	10	1¼	—	8 0 0
Gen. Elec. Pref.	6	6	10⅜	—	6 2 4
do. Ord.	10	10	17½	—	*5 12 8
Henley	25	25	2½	—	5 11 2
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	17¾	+ ¼	*5 12 8
Telegraph Con.	20	20	46	— ½	*5 0 0

*Dividends paid free of Income Tax.

ELECTRIC SPOT WELDING.*

By G. A. HUGHES and R. H. POOL.

To decide whether it is better to rivet or to spot-weld an article one must take into consideration the use of the article, and not base the decision on the cost of obtaining a desired strength. In light work spot welding can successfully replace riveting in 90 per cent. of the cases. There are numerous conditions where it is impossible to use rivets because the stock will not permit the punching of the hole, or because the rivet head is objectionable. Special spot-welding machines can be made to take care of the difficult shapes, and thus reduce the cost of an article in the saving of the rivets and dies, maintenance of dies, and labour in laying out and punching the stock. An ideal condition for spot welding is where a smooth surface is desired and the material does not permit the countersinking of the rivet heads. The thickness of material that can be successfully welded will depend entirely upon its size and shape, together with the rating of the welding machine. The writers have seen two pieces of ½-in. (1·27-cm.) material—a total thickness of 1 in. (2·54 cm.)—welded on a 30-kw. machine.

The data are intended to give an idea of (1) power consumption, (2) strength of the weld, and (3) speed at which welds can be made. All the tests on which the data are based were made on 30-kw., 220-volt, 60-cycle, hand-operated machines made by the Federal Welding and Machine Co., of Warren, Ohio. Fig. 1 shows its standard 449-B machine. The machines were in service for two hours before the tests were made. This was to allow for the heating of the machines. Each machine had an auto-transformer in the primary circuit of the welding transformer to control the welding current. Taps were provided on the auto-transformer to adjust the primary voltage in eight steps from 65 per cent. to full-line voltage.

In making the test recorded in Table I, three plates of soft steel $\frac{5}{16}$ in. (4·8 mm.) thick were used, making a total thickness of $\frac{15}{16}$ in. (13·2 mm.). The first three welds were made with the auto-transformer on tap 5. The time of welding varied from 42 to 44 seconds and the power demanded from 17 kw. to 18·4 kw. The fourth and fifth welds were made with the auto-transformer on tap 7. The time of welding was 30 to 31 seconds and the power demanded 24 kw. to 25·6 kw. All of the welds were satisfactory. (Note the power factor.) An attempt was made to weld on tap 8, but this was unsuccessful, as the material next to the copper contacts would become hotter than the centre plate and would be forced out from under the contacts, and thus burn the material at the point of welding.

An attempt was made to determine the proper pressure for the contacts while welding, since the presence of the scale and rust caused considerable arcing and burning of the material under the contacts, forcing the molten metal out, and thus leaving a bad weld, although it would have the appearance of a perfect one. Upon cutting into the weld, however, it would have the appearance of a honeycomb. To avoid this trouble it was decided first to burn the rust and scale off. This was accomplished by forcing the welding contacts firmly on the material and then turning the power on the welder for a moment. This method removed the scale and assured a good contact between the welding points and the material. Then the power was turned on and the material brought up to a welding heat without arcing. This saved the cleaning of the stock and added about 50 per cent. to the life of the welding points.

To determine the kilowatt-hours consumed in a day's run, an integrating watt-hour meter was installed. Some conclusions made from these readings are :—

1,480 welds of two pieces No. 18 gauge sheet steel.
1,050 welds of four pieces No. 16 gauge and one piece $\frac{1}{16}$-in. plate.

2,530 welds total in 10 hours. Energy consumed, 42 kw.-hours.

680 welds of two pieces No. 18 gauge sheet steel.
1,350 welds of four pieces No. 16 gauge and one piece $\frac{1}{16}$-in. plate.
545 welds of one piece of No. 18 gauge and one piece of $\frac{1}{8}$-in. mild steel.

2,575 welds total in 10 hours. Energy consumed, 35 kw.-hours.

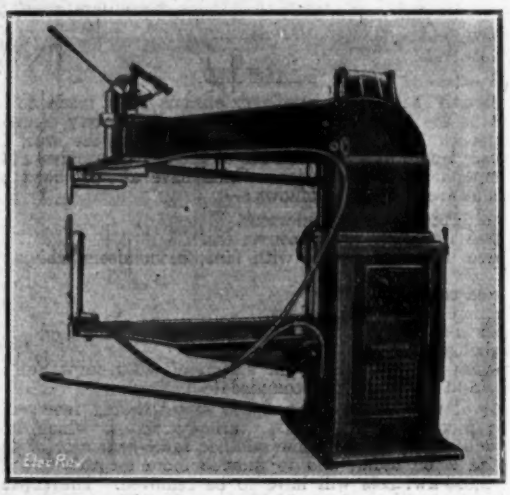

Fig. 1.—Standard Spot-welding Machine.

TABLE I.—Data Obtained Using Three $\frac{5}{16}$-in. Plates.

Volts.	Amp.	kw.	p.f.	Size of spot. In.	Tap of auto-transformer.	Time, seconds.	Condition of materials.
232	186	17·6	0·41	$\frac{1}{4}$	5	44	Free from rust
232	176	18·4	0·45	$\frac{1}{4}$	5	42	
232	180	18·1	0·43	$\frac{1}{4}$	5	44	
230	256	25·6	0·48	$\frac{1}{4}$	7	30	
230	248	24·0	0·42	$\frac{1}{4}$	7	31	

TABLE II.—Data Obtained Using Two $\frac{5}{16}$-in. Plates.

Volts.	Amp.	kw.	p.f.	Time in seconds.	Tap of auto-transformer.	Condition of material.
218	208	26·4	0·57	24	7	
218	224	26·0	0·53	22	7	
218	244	26·4	0·53	24	7	Scale
218	228	26·8	0·54	22	7	and rust
218	216	26·0	0·55	22	7	were
218	224	26·4	0·54	26	7	present.
218	220	25·5	0·53	25	7	
218	224	28·0	0·57	22	7	

TABLE III.—Data with Different Material.

Volts.	Amp.	kw.	p.f.	Time, seconds.	Tap of auto-transformer.	Size of spot, in.	Material used.
220	244	24	0·54	15	7	$\frac{5}{16}$	Two $\frac{5}{16}$-in. mild steel plates
220	260	20	0·35	20	7	$\frac{5}{16}$	Two $\frac{5}{16}$-in. "Vasco" non-shrinkable steel plates.

TABLE IV.—Comparison of Spot-Welded and Riveted Joints.

Test No.	Size of spot, in.	Condition of sheets, and contacts.	Maximum load, lb.	Nature of failure.	No. of spots.
1	$\frac{1}{16}$	Free from scale. Contacts good.	4,460	Welds pulled out	1
2	$\frac{1}{16}$	Free from scale. Contacts good.	7,250	Welds pulled out	2
3	$\frac{1}{16}$	Free from scale. Contacts good.	10,920	Welds pulled out	3
4	$\frac{1}{16}$	Scale on sheets. Contacts poor.	4,460	Welds sheared	2
5	$\frac{1}{16}$	Rust and scale. Contacts good.	8,100	Welds sheared	3
6	Two $\frac{1}{4}$-in. rivets, holes drilled and rivets inserted with care.		4,700	Rivets sheared	—
7	Two $\frac{1}{4}$-in. rivets, holes drilled and rivets inserted with care.		5,200	Rivets sheared	—

All tests were on No. 14 gauge sheets, steel 3 in. wide, single lap-joint, single-shear.

TABLE V.—Tension Tests on Spot-welded Joints.

Test No.	1	2	3	4	5	6	7	8
Maximum load, lb.	3,700	3,740	6,470	6,195	4,980	4,980	7,880	7,790
Nature of failure	Weld pulled out	Weld pulled out	Weld pulled out	Weld pulled out	Weld pulled out	Weld pulled out	Plate failed	Plate failed
No. of spots	1	1	1	1	2	2	2	2
Kind of joint	Lap Single shear	Lap Single shear	Butt Double shear	Butt Double shear	Lap Single shear	Lap Single shear	Butt Double shear	Butt Double shear

Material tested.—No. 16 gauge sheets, 3 in. wide; welds, ¾ in. spots.

In making the tests indicated by Table III it was impossible to obtain two results alike, owing to the different chemical analysis of the steel.

Forcing the Yield of Oil Wells by Electricity.—The yield of an oil-well may be diminished, and in some cases stopped, by the cooling of the rock-beds due to ingress of air. The crude oil is thereby thickened, and its flow through the crevices and porous channels in the beds is checked or wholly arrested. The remedies commonly used are hot water, steam, or hot air. These, however, are effective for only moderate depths. The recently devised method of applying an electric current to the warming of the oil avoids this difficulty, and moreover offers special advantages. The oil is heated without loss, and, much gas being generated, a pressure is set up which in some cases has forced the oil to the surface in bore-holes of great depth. The system is as effective in wells a thousand metres deep as in those of little depth. The military commands have used the system of electrical heating to restore to working order temporarily abandoned mines in Galicia and Roumania.—*Chemiker und Techniker Zeitung.*

* *Electrical World* October 19th, 1918.

ELECTRICITY SUPPLY PROGRESS IN WAR TIME.

In our issue of November 22nd (p. 487), we gave a schedule of electricity supply undertakings which had carried out extensions during the war, stating the amount of plant installed or ordered for that purpose. To supplement this schedule, we have obtained particulars of the extensions from the engineers responsible for them, and give them in brief below. As the data have not all come to hand as yet, we are unable to adopt a systematic classification, and therefore they will be inserted as circumstances permit. We trust that these particulars, with the comments of the engineers attached, will be of interest to our readers.

BRADFORD.

Not only have considerable extensions been made to the plant of the City of Bradford (Mr. T. Roles, city electrical engineer and manager) during the period of the war, but further important extensions are at present in progress. The principal items of extensions which have already been carried out are roughly as follows:—

One 5,000-kw. turbo-generator.
Three 1,500-kw. rotary converters.
Three boilers, complete with fans, economisers, chimneys, &c.
Three cooling stacks.
Suction ash-handling plant.
Coal conveyor.
Switchgear.
Storage battery, having an output of 5,000 amps. for one hour, and building to accommodate battery.

One of the 1,000-kw. low-speed sets is being removed to make room for a 12,000-kw. turbo-generator, which is in course of construction, while another turbo-generator of similar size is on order, and to provide room for this two further 1,000-kw. sets will have to be removed. The capacity of the generating plant, 16,800 kw. in 1914, will thus be raised to 44,250 kw.

BURY.

The County Borough Council of Bury contemplated considerable extensions at the time when war was declared, but at the request of the Government these were held up. A 3,000-kw. turbo-alternator ordered at the beginning of 1914 was installed, and at a later date, with the sanction of the Ministry of Munitions, a 45,000-lb. boiler was added to the plant. The rated output has thus been increased from 5,700 to 8,700 kw.

During the past four years the electricity department has had to refuse new business to the extent of some 4,000 h.p. through inability to carry out extensions; these applications have not been from industries established specially for war purposes, but from others normally engaged on export or the home trade.

The output has been well maintained, mainly through the extra demand of munition makers coinciding with a falling off in the requirements of other trades, such as textiles and paper-making; no doubt this process will now be repeated in the reverse direction.

The borough electrical engineer and manager, Mr. S. J. Watson, thinks it was a mistake to restrict extensions of modern works, particularly from the fuel point of view. A number of power users in his area who wanted to use the public supply, but whose demand could not be met, have temporarily brought into use second-hand prime movers or old plant requiring much more fuel per unit than a power station, and they will certainly have to wait 18 months or two years before an increased public supply can be provided. In some cases this will retard the establishment of useful industries. He considers that the prospects for an increased use of electrical power in Bury are distinctly good, and everything possible should now be done to ensure that these demands can be met. As a system of priorities will probably be continued for some time to come, and industrial development is now of first importance, and cannot properly be dealt with without an ample supply of cheap power, extensions of power stations should be facilitated by the highest priority certificates.

MAIDSTONE.

In the very early days of the war the Borough of Maidstone (Mr. E. E. Houdley, engineer and manager) put in a 1,250-kw. Ljungström turbine, with a 1,000-kw. rotary converter; this was partly to replace some small 150-kw. Peache-Parker and Westinghouse sets, of which originally five were installed. On the outbreak of war, three of these were taken for purposes of wireless telegraphy, one to go somewhere in the Egyptian desert, and the other two to the Isle of Ascension. Since then the borough has got rid of the other two—one to an aeroplane factory and the second to a colliery—and is now erecting a second Ljungström set, but of 1,750 kw. capacity, giving a three-phase supply at 6,600 volts, with the necessary e.h.t. switchgear and transformers. An e.h.t. cable is being laid to a sub-station equipped with a 1,000-kw. rotary converter and the necessary transformers.

In the boiler-house a 30,000-lb. Thompson water-tube boiler is being installed, fitted with Class "A" travelling grate stokers, by the Underfeed Stoker Co., which are capable of burning either anthracite or coke breeze. A complete mechanical coal-handling plant, consisting of elevators and conveyors, has been installed by Messrs. Ed. Bennis & Co., Ltd., and the Council has also purchased a 3¼-ton electric coal wagon for carting coal, an air compressor for cleaning electrical machinery, and a 100-kw. balancer. All this plant has been installed to meet the additional demand which has been experienced, chiefly from large extensions to the power supply; most of the new connections have been used for the production of munitions, some of which have been of the very highest importance. The plant capacity before the war was 2,075 kw., and is now over 4,300 kw.

The borough is in an exceptionally fortunate position, as the whole of the load that has been obtained will simply switch over at once to peace-time productions, which were the staple output of the factories before they were put on to war work, and the authorities look forward to very large developments in electricity supply in Maidstone and its immediate neighbourhood in the near future.

RUNCORN AND WIDNES.

The Mersey Power Co., Ltd., had a small station at the beginning of the war, of a total capacity of 3,000 kw., with 1,500 kw. spare; this has been running on a 17 per cent. load factor for the last two and a half years. Recently the company has put in a new 3,000-kw. set, which is now on load, but which took 18 months to get. The total plant capacity has therefore been raised from 4,500 to 7,500 kw. The company is now designing and obtaining quotations for a 100,000-kw. station on the shores of the Ship Canal, beginning operations with two 12,000-kw. units.

SLOUGH AND DATCHET.

The Slough and Datchet Electric Supply Co., Ltd. (Mr. A. E. Farrow, general manager) has in hand a scheme for which the plant has not yet been received (although certificates have been granted, and it is hoped to have the plant in running order by next March); the company intends to install a 1,000-kw. Ljungström turbine in its works at Slough, and to generate there all electricity, both for itself and for the Windsor Electrical Installation Co. At the present moment it is laying a trunk main between Slough and the Windsor works; also it is putting down rotary converters at Slough for converting a.c. to d.c., and utilising the existing dynamos at Windsor, driving the latter with three-phase motors. Eighty per cent. of the load is for power purposes. The original capacity of the plant was 695 kw., and the extensions will bring it up to 2,030 kw.

SHEFFIELD.

At the outbreak of war the electricity supply department (Mr. S. E. Fedden, general manager) was installing an 8,500-kw. turbo-alternator at Neepsend. Orders were placed for a similar set and the corresponding boilers, and in 1915 a 2,000-kw. set and a 9,000-kw. set were commandeered, boilers were ordered, and the extension of the building was pushed forward night and day. Still the demand increased, and at the beginning of 1916 additional plant was ordered, being brought up to 68,225 kw. in 1917, as compared with the total rated capacity of the city electrical undertaking of 23,225 kw. in 1914—a total increase in three years of no less than 45,000 kw. During the same period the mains were greatly extended, 91 miles of cable being laid, new sub-stations were built and equipped, and new switchgear and other apparatus was installed at the power station and many of the existing sub-stations. During part of the time the whole of the generating plant was working continuously on overload. In addition to the above, a new power station is now being erected to accommodate plant of a total capacity of 28,000 kw., and an additional extension of 50,000 kw. has been authorised, which will bring the total rated output up to 146,225 kw.

WATFORD.

The staple trades at Watford, namely, printing and brewing, were badly hit by the war, and the growth and turnover of other industries to munition making has not done much more than counterbalance the loss sustained by the undertaking through the restrictions imposed upon these trades. Good steady progress has been made, in spite of difficulties, and various new businesses have been supplied from the Council's mains, such as printing for a Government department, the manufacture of saccharine and medicinal chemicals, and the driving of one of the largest magneto factories in the country. These will no doubt remain on the mains, but purely munition works, such as filling factories, &c., will probably disappear. In one respect the conditions are favourable, inasmuch as the bulk of the munition work has been a change-over to war work, and therefore the change to peace conditions should be easily accomplished.

The prospects are very good, seeing that the district generally is very healthy, and there is plenty of land suitable for factory sites, with corresponding residential sites, within the electricity supply area, which is served by two railway lines, with a third extending into it shortly. The works of the Urban District Council (Mr. A. W. Barham, chief engineer) are being modernised to meet present conditions, and

a 1,250-KW. Ljungström turbine (at 0.8 power factor) is being installed to cope with the additional loads. This will bring up the total rated output of the plant from 2,500 to 3,750 KW.

TONBRIDGE.

The output for private supply has been much reduced owing to Government regulations, and practically no new business has been done. There has been a considerable increase, however, due to supplies to munition factories in the district, and new mains to the value of £5,000 have been laid. New generating plant of 570 KW. has been sanctioned, and part of this has been installed. The new plant consists of a 170-KW. Willans-Crompton Diesel set and a 400-KW. Willans-G.E.C. turbine set, raising the plant capacity from 370 to 940 KW. Bennis mechanical stokers have been fitted to the existing boilers. The Urban District Council (Mr. M. P. Plunkett, electrical engineer) has under consideration a scheme for utilising the water power at the Town Mills, which property it has recently acquired.

MANCHESTER.

Just before the outbreak of war the rated capacity of the generating plant of the Manchester Corporation (Mr. S. L. Pearce, engineer and manager) amounted to 76,000 KW., the first 15,000-KW. turbo-alternator (a Howden (Zoelly)-Siemens set running at 1,000 R.P.M., with surface condensing plant of 24,000 sq. ft. by Richardsons, Westgarth & Co., Ltd.) having been started up in June, 1914. It was originally contemplated that at this stage in the development of the Manchester electricity system—the Barton site having been acquired—no further plant would be installed at Stuart Street. But it was not then possible to proceed with the Barton project, and, in view of the most urgent demands for power arising from the war, extensions were carried out at the Stuart Street station.

During 1915 and 1916 two 6,000-KW. turbo-alternators running at 3,000 R.P.M. were put down, the first a Westinghouse-Siemens combination, and the second a Westinghouse-Westinghouse. The jet condensing plant was supplied by Mirlees, Watson & Co., Ltd. These two 6,000-KW. sets took the place of two of the original six 1,500-KW. engine sets. All of the latter have now been removed.

In the early part of the present year the installation of a second 15,000-KW. turbo-alternator was completed. This comprises a Richardsons, Westgarth turbine coupled to a Westinghouse alternator running at 1,500 R.P.M., with surface condensing plant of 30,000 sq. ft. by the first-named firm. This new unit replaced one of the two 3,750-KW. Wallsend-Slipway-Electrical Co. engine sets. There is further on order for delivery by the end of this year a 20,000-KW. turbo-alternator set running at 1,500 R.P.M., also of Richardsons, Westgarth, and Westinghouse construction, coupled to a Richardsons surface condensing plant of 40,000 sq. ft. cooling surface. The alternators of both sets are capable of easily maintaining a continuous output of 20,000 KW. and 25,000 KW. respectively.

By the end of the present year therefore the total capacity of the plant installed at Stuart Street will be 100,250 KW.

A clean sweep is being made of the original 24 10,000-lb. boilers in No. 1 boiler-house. Between 1909 and 1915 two Babcock & Wilcox 30,000-lb. land type boilers and six 45,000-lb. marine type boilers were added. During 1916 and 1917 four Babcock & Wilcox 60,000-lb. marine type boilers were installed.

There are under construction two boilers of a similar type, but of even larger capacity than the foregoing. They are expected to be capable of giving easily and continuously 100,000 lb. of steam per hour when burning coal having a calorific value of 11,000 B.TH.U. Two additional units of this size are on order for completion during 1919.

At the Bloom Street station in 1914 a traction battery of 4,000 ampere-hours capacity—3-hour rating—by the Chloride Electrical Storage Co., Ltd., and in 1917 a 10,000/12,000-KW. Westinghouse-Westinghouse turbo-alternator running at 1,500 R.P.M., with surface condensing plant by the same company, were installed. The latter has superseded one of the four original 1,800-KW. Musgrave-Westinghouse engine sets.

CLYDE VALLEY.

The Clyde Valley Electrical Power Co. (Mr. R. Robertson, commercial manager) is in course of increasing its capacity from 35,000 KW. in 1914 to 75,000 KW. The following are particulars of the generating plant installed or under construction since August, 1914, at the company's generating stations:—

Two 5,000-KW. Westinghouse turbo-alternators, 11,000 volts, three-phase, 25 cycles, now in operation.

One 15,000-KW. ditto ditto, expected to be in operation in March, 1919.

One 15,000-KW. ditto ditto, under construction.

HACKNEY.

The Metropolitan Borough of Hackney (Mr. L. L. Robinson, M.Inst.C.E., borough electrical engineer) has increased its generating plant from 4,800 KW. in 1914 to 13,400 KW. in 1918. Part of the new plant is now being installed. Messrs. Babcock & Wilcox, Ltd., are supplying two boiler units, each comprising land type boiler, integral superheater, chain-grate stokers, Green economiser and induced-draught plant, and Weir turbine feed pump. The boilers are rated at 33,000 lb. per hour, and have a heating surface of 8,283 sq. ft. (+ 1,980 sq. ft. superheater), working at a pressure of 225 lb. per sq. inch, and a final temperature of 600 deg. F. Messrs. C. A. Parsons & Co., Ltd., are providing a turbo-alternator of the pure reaction type, with a normal output of 6,000 KW. at 0.8 power factor, running at 3,000 R.P.M. The condenser, of 9,500 sq. ft. cooling surface, will give a vacuum of 28.4 in. with barometer 30 in. at 6,000 KW., with 8,000 gallons per minute at 70 deg. F. cooling water. The air pumps are of the Edwards type, and the circulating pumps are Rees Roturbo. The guarantee is 11.9 lb. steam per KW.-hour at full load. Messrs. Ferranti, Ltd., are installing a panel for the 6,000-KW. generator.

(To be continued.)

THE SUPPLY OF SINGLE-PHASE POWER FROM THREE-PHASE SYSTEMS.

By PROF. MILES WALKER, D.Sc., M.I.E.E.

(Abstract of paper read before the INSTITUTION OF ELECTRICAL ENGINEERS.)

A VERY large proportion of the electrical power stations of the world generate alternating current in three phases; there are, however, some purposes for which single-phase current is to be preferred, as, for instance, in high-voltage alternating-current traction systems. Another purpose for which single-phase power is required at the present time is the operation of electric furnaces. There can be no doubt that, putting aside all considerations of convenience of electric supply and looking at the objects to be attained merely from the metallurgical point of view, the single-phase furnace has much to recommend it. Nevertheless, on account of the great objections raised by the suppliers of electric power to the unbalancing effect of a single-phase load upon their three-phase systems, the polyphase furnace is in much more extensive use in this country than the single-phase furnace.

In view of the very extensive use that will be made of electric furnaces for steel manufacture in the future, it is important to see what can be done to minimise the objection of the suppliers of electric power to a single-phase load.

The main objections to the single-phase generator are the following: The cost for a given output is higher than for a three-phase generator; for instance, the cost of a 25-cycle single-phase generator of 5,000-KW. capacity, running at 1,500 R.P.M., would be about 30 per cent. higher than that of a three-phase generator of the same characteristics. This is partly because the single-phase output from a given frame is less than the three-phase output, and partly because a single-phase generator must be provided with a very heavy and well-constructed amortisseur on the field magnet, the cost of which is a considerable item. Secondly, the efficiency of a single-phase generator is considerably lower (from 1½ to 2 per cent.) than that of a three-phase generator of the same rating. This is caused partly by the higher iron losses due to the single-phase armature reaction, and partly by the loss in the amortisseur and the metal surrounding it.

Where the load is divided between a number of locomotives or a number of furnaces which are not started simultaneously, it is possible to divide the whole into two parts, putting one part on to one phase of a two-phase generator and the other part on to the other phase. It may be that such an arrangement gives a balance of load that is good enough for practical purposes; and if the generator is constructed with an amortisseur so as to take a single-phase load without injury, this arrangement is perfectly satisfactory. Similarly, three independent loads can be taken from a three-phase system.

An appendix gives the graphic construction for finding the voltage change in each phase when a single-phase load is thrown on one phase of a three-phase generator, and it is established that if the single-phase load (even of low power factor) does not exceed 20 per cent. of the normal three-phase load the disturbance to the voltage is inconsiderable. An instance of this kind is found at Bradford, where single-phase furnaces of 400-KW. capacity are thrown on and off three-phase mains without causing a noticeable unbalancing of the voltages.

In some cases where power companies have refused to connect a single-phase load on to their systems, motor-generators have been installed. With a synchronous motor driving the single-phase generator, the set may be used for improving the power factor of the system by over-exciting the synchronous motor. For general convenience of operation this method is entirely satisfactory; the consumer has complete control over his own voltage; the power factor on the three-phase side can be adjusted at will; and the maximum demand can be kept within bounds, notwithstanding the heavy currents that may be drawn from the single-phase generator at times of short circuit. The main drawbacks to this plant are the high first cost and the poor efficiency. Owing to the low efficiency of the single-phase generator, especially when built with heavy armature conductors for large currents, the efficiency of the whole set is usually very poor. A 500-K.V.A. set has an efficiency of about 85 per cent.

In order to secure a higher efficiency than can be obtained from a motor-generator, and a better specific use of the material employed, a number of different types of balancers have been proposed for balancing a three-phase system that would otherwise be thrown out of balance by a heavy single-phase load. These may consist either of stationary apparatus, such as choke coils or condensers, or of running machines, which may be either synchronous or asynchronous.

The generating plant in a three-phase power station might conceivably be so large and its impedance so low that quite a large single-phase load might be thrown on one phase, and yet the voltage might remain practically undisturbed; so that from *the consumer's point of view* the system might be considered in balance. It is necessary to distinguish between unbalanced currents and unbalanced voltages; and in considering voltages and currents, their phases and wave-forms are important as well as their virtual values.

If a symmetrical generating system has impedances of finite value, any departure from the conditions of balance in the currents causes a want of balance in the voltages. On the other hand, if the impedances in the generator and line are unsymmetrical, the voltage at the consumer's terminals will be unbalanced even when he draws currents that are balanced in ampliture and phase. If the voltages at the terminals of consumer S are unbalanced (owing, let us say, to an unsymmetrical load drawn by consumer U), a load of symmetrical polyphase machinery having small impedance, when put in circuit by consumer S, will have the effect of bringing the voltages more nearly into balance. This is due to the fact that the line supplies unbalanced currents to S's symmetrical apparatus, so that even if the effect were almost to balance the voltages S can justly complain that his load is unbalanced. He would, in fact, have unequal heating in his windings, owing to the unsymmetrical loading of U's apparatus. Meanwhile, the central-station engineer might be congratulating himself on the fact that his voltages and currents were very nearly balanced. If, therefore, we wish to make a complete statement of the want of balance on any system, we must be precise as to the part of the system under consideration, stating whether the voltages are unbalanced as to amplitude or phase, and whether the currents are unbalanced as to amplitude or phase. This is all on the assumption that the voltages and currents are of pure sine wave-form; if not, there are very many more ways in which the system and parts of the system may be unbalanced.

As Steinmetz has pointed out, there is another test of the balance of the loads. If the sum of the three alternating components of the power is zero, the load is balanced in the sense that the power flows from the generator in an even stream; but if the sum is not zero there is a fluctuating flow of power from the generator.

But it may happen that the amplitude and phase of three alternating power components are such that the three vectors representing them would form the sides of a triangle with the arrow-heads (showing the sense of the vectors) following one another consecutively. In this case the alternating components of the power balance one another, although it may be that neither the currents nor the voltages are balanced.

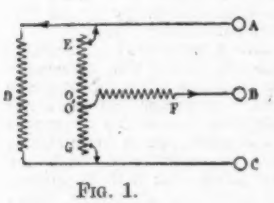

Fig. 1.

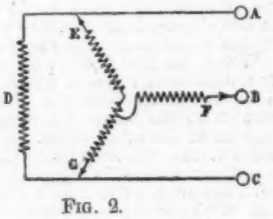

Fig. 2.

Where a polyphase load has been unbalanced by the addition of a single-phase load, it may be balanced by the addition of a wattless load taken by a choke coil or a condenser.

If we apply this method to the balancing of a three-phase circuit which is carrying a single-phase load, it will be found that for some loads the addition of the choke coil gives a true balance; but that for other loads the balance (while it is such as to bring to zero the resultant alternating components of power) is not such as to comply with conditions of balance of voltages and currents.

The addition to the system of the choking coil in question, while it brings about a balance, increases the wattless load on the system. Now that condensers of large capacity can be manufactured at fairly reasonable prices, it would be possible to use a condenser instead of a choke coil, with the effect of improving the power factor at the same time as balancing the load. Such an arrangement, however, has the drawback (apart from its first cost) of requiring to be switched in and out with the furnace load.

A running machine such as a synchronous motor or asynchronous motor is able to take energy from the circuit at one part of a cycle, store it as kinetic energy, and return it to the circuit at another part of the cycle. In this way it is able to neutralise the alternating component of the power. Any symmetrical three-phase motor or generator running on the system and having an armature of low impedance will help to balance the voltages on a system when the voltages are unbalanced, by taking unbalanced currents from the line.

If the armature impedance is not negligibly small, it is possible to obtain balance by connecting some kind of boosting appliance in series with the balancer to compensate for the impedance drop in the armature. In this way a comparatively small balancer can be compelled to take an unsymmetrical load sufficient to balance perfectly the voltage of the system. The main distinction between different kinds of balancers lies in the kind of boosting appliance employed.

The balancer may be either synchronous or asynchronous. A synchronous balancer can be used to correct the power factor of the system, whereas an asynchronous machine usually throws a lagging wattless load on the system.

(*a*) *Unsymmetrical Numbers of Turns on Balancer Winding.*—Fig. 1 shows a single-phase load D supplied from a three-phase supply, the terminals of which are A, B, and C. A balancer is shown with its windings E, F, G connected so as to balance the load. The windings E and G together may form one of the phases of a two-phase generator, F forming the other phase. In this case the number of turns in F is

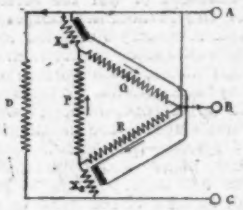

Fig. 3.

arranged so as to give a symmetrical three-phase voltage at the terminals. Or, if preferred, the winding E, F, and G may be wound as an ordinary three-phase generator (fig. 2). In either case tappings are brought out from E G near the star point so that the inner end of F may be connected in an unsymmetrical manner. Tappings may also be brought out near the outer ends of E and G.

The drawback to the use of these unsymmetrical connections is that at no load they cause as much out-of-balance as they cure when the load is on.

(*b*) *Boosting Transformers in Series with Balancer Windings.*—It is possible to compensate for the inductive drop in the balancer windings by injecting electromotive forces of the right amount and phase, by means of transformers, in series with the balancer windings. In 1915 experiments were made to see how far a synchronous motor could be made to operate as a balancer by means of injected E.M.F's. The connections are shown in fig. 3. It was found that a rotary converter could be made to balance the currents to within 6 per cent. of the mean current; this was good enough for practical purposes. The rotary converter, in addition to balancing the load, provided all the wattless current for the single-phase load, the current from the alternating-current generator being drawn at unity power factor.

It was found that if the single-phase load was thrown off with the boosting transformer still in action, the rotary converter took from the alternating-current generator an unbalanced load of a magnitude comparable with the single-phase load thrown off. In fact, for every change of the single-phase load it was necessary to alter the taps of the boosting transformer, and for different power factors of the single-phase load it was necessary to take different combinations of phases in order to supply a boosting voltage in the right phase.

It was thought by the author that it should be possible to combine in one machine the balancing and power-factor-correcting functions of the synchronous motor with the functions of a step-down transformer and boosting transformer. This combination has been made in the balancer described in the paper.

This rotating balancing transformer absorbs the balanced three-phase power in one winding, and supplies a single-phase load from an independent winding. A balancer of this kind is of special interest in connection with single-phase electric furnaces.

The main advantages claimed for the single-phase furnace are as follows: In the first place, only two electrodes are required instead of three; and as these can be brought into the furnace at two diametrically opposite points the liability of the arc to cause a short-circuit through the hot semi-conducting lining is very much reduced. This enables the voltage between the terminals to be raised to a value almost double that which is practicable for a polyphase furnace. The increase in the voltage leads to a corresponding reduction in current for the same power input; the smaller current leads to economy in conducting cables and contacts, and enables a much smaller electrode to be used than is possible in the polyphase furnace. As the electrode losses are dependent upon the surface of carbon exposed and also upon the amount of air-leakage through the furnace, the reduction in the number and size of the electrodes and in the number and size of leakage holes results in a great saving in electrode consumption. In the second place, the single-phase furnace has an exterior shape which approaches a spherical form;

the radiation losses are thus reduced to the smallest possible for a given content.

When the purpose is to supply a single-phase current to an electric furnace, the source of supply being an ordinary three-phase system, there is an advantage in using a special kind of balancer which shall fulfil the functions of (1) voltage transformer, (2) balancer, (3) reactance, and (4) power-factor corrector. These functions can, of course, be performed by a motor-generator set designed with suitable characteristics; but the first cost of a motor-generator set is higher than that of a balancer of the same output, and the efficiency is lower. More clearly to understand the functions of such a balancer, something should be said of the advantages (from the user's point of view) of working a single-phase furnace with an inductance in circuit sufficient to make the current lag by 45 deg. behind the voltage.

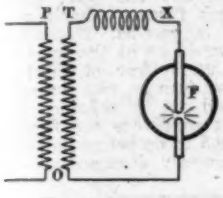

Fig. 4.

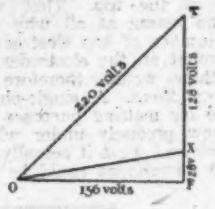

Fig. 5.

Consider the circuit shown in fig. 4 where O P is the primary winding of a transformer, O T its secondary winding, T X a choking coil, and F a single-phase furnace. In the vector diagram, fig. 5, let O T represent the voltage generated by the secondary, X T the reactive drop in the choke coil (with which may be included any reactive drop in the transformer); P X the reactive drop in the furnace, and O F the resistance drop in the furnace and the rest of the circuit. If this diagram represents the full-load working conditions, then the full-load current is lagging 45 deg. behind the voltage, and is represented to some scale by the line O F. When the inductance and resistance are adjusted to give these conditions on full load, and the inductance is maintained constant, the voltage O T being constant, the input to the furnace cannot exceed the full-load value however the resistance of the circuit may be varied. In fact, if we change the resistance of the furnace from infinity to zero, the current will increase from 0 to 1.41 times full-load current, and the power at various values of the current will be given by the curve in fig. 6. The full-load value of the current gives the highest point of the curve. Any reduction of the resistance of the furnace beyond this point causes a decrease in the input, although the current is slightly increased. If the furnace is short-circuited, the input falls to zero and the current cannot exceed 1.41 times full-load current.

These conditions give stability in operation, and are of great importance in preserving the lining of the furnace. No really refractory substances can be obtained for the lining of electric furnaces. The best commercial substances, such as dolomite, magnesite, or silica brick, have melting-points not very far above the temperature at which it is desired

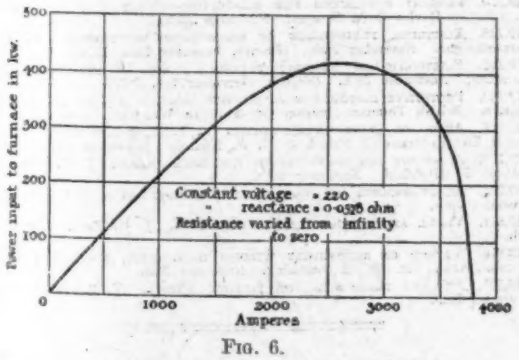

Fig. 6.

to work the furnace. If by any unfortunate chance part of the lining reaches a temperature above its melting-point, it begins to blend with the contents of the furnace, causing trouble with the pouring and heavy expense in re-lining. Now the maintaining of the furnace at its proper temperature depends upon the maintaining of the balance between the electrical input and the energy absorbed and radiated. If the characteristics of the circuit are such that an increase in the current is accompanied by an increase in the electrical input, the greatest care must be exercised, when the furnace is at full load, to keep the current near its full-load value; and this is difficult by reason of the unstable nature of the arc. Automatic regulators are often installed to keep the current within bounds, but even these are not found to be sufficient during the first twenty minutes after the furnace has been started up from the cold; and in some three-phase furnaces, where no great amount of inductance is connected in circuit, it is necessary to have three operators (one at the regulating wheel of each carbon), with their eyes fixed on the ammeter, to screw up and down the carbons every few seconds in order to keep the currents approximately balanced. After the furnace has been heated fairly well, the lengths of its arcs are greater, and the regulating can then be handed over to a regulator of the Thury type.

Where sufficient inductance is put in series with the furnace, the circuit becomes automatically stable and no such regulators are required. The ideal condition for steady running is attained when the inductive drop at full load is equal to the resistance drop, as shown in fig. 6. In some cases, the transformers that supply the furnace are built in such a way as to have their magnetic leakage great enough to give the required inductive drop. In designing transformers for this purpose, care must be taken to see that the cross-section of any iron added to the leakage paths is sufficiently great to give a fairly straight-line law for the increase of the leakage flux with the current, right up to the point 1.41 times full-load current; otherwise it may be found that when the furnace is short-circuited the current taken is much more than 1.41 times full-load current, and trouble may arise with the power company supplying the three-phase power. A case came to the notice of the author in which failure to provide a sufficient cross-section for the reactive iron resulted in undue disturbances to the power system and great loss of furnace linings.

(To be concluded.)

Discussion.

Dr. S. P. Smith congratulated the author on the excellence of his paper, and hoped the balancer which he had developed would meet with all success. He mentioned that the author had recently presented a thesis on the same subject which had gained him his science doctorship (Lond.). The study of vectors was full of interest, not only so, but as the paper under discussion had proved, quite correct solutions could be arrived at therefrom. After referring to one or two problems of load balancing, he said that he had noted that when several arcs were thrown on to a three-phase system the ammeter needle gave several violent swings; by the system described in the paper such disturbances could be entirely eliminated. He thought that electric furnaces, especially small ones, should render good service to electrical firms. Such firms usually had considerable amounts of scrap steel turnings, &c., which could very easily be reclaimed by the use of a single-phase furnace in the same way that cast-iron scrap was dealt with.

Mr. G. W. Partridge asked the author if it were possible to reverse the process described, could a three-phase supply be obtained from a single-phase system? If so a supply of single-phase could be taken for heating, lighting, and small furnaces from a large three-phase network, which arrangement might be desirable under certain circumstances. He thought that single-phase current would come to be used for most furnace work, especially for small furnaces. He also referred to a large-capacity induction type furnace to which reference had recently been made and to the importance of single-phase current, and the converting of the same from three-phase for railway work.

Mr. Bibby criticised the advantages that were claimed for the single-phase furnace; there was nothing in such a type of furnace that was not also practicable with the three-phase type. He said that a short fat arc was preferable to a long high-voltage arc, and he did not think the use of single-phase current would bring about a reduction in copper in the conductors, because with three-phase there were two arcs in series. He also criticised the shape of the furnace; the reason why a spherical furnace was adopted when single-phase current was used was so as to get the best advantages of the latter. Such a shape of furnace was not the best for steel making. Two operations had to be performed by an electric furnace, first the metal had to be melted, and then the steel had to be manufactured. A single-arc furnace would perform the first operation satisfactorily, but it was of not much use for the second operation.

Mr. Etchells said that certain statements made, both by previous speakers and also in the paper, needed explanation. There was nothing to recommend the single-phase furnace, whereas the three-phase type of furnace both melted the metal and also gave the necessary chemical treatment after melting. The furnace had a definite function to perform, and it should be thoroughly understood what that function was. He referred to the necessity of keeping the voltage between the electrodes low and the power factor as high as possible. With a 4-electrode, 3-K.V.A. furnace the maximum kick recorded was 1,200 KW.; the power factor was 0.9, and it was therefore not necessary, he submitted, to install rotary machinery in order to arrive at the same results. Besides, steel makers had a great dislike for rotating machinery, and it should not be introduced if it could be done without. The spherical form of furnace was not good; it was desirable that the bath should be shallow compared to its diameter, and that condition did not obtain with the spherical shape. He wondered whether trouble with high-frequency harmonics would be encountered with the system described, and would the author say whether the phase balancing depended upon a current lag of 45 deg.

at full load, as stated on p. 15 of his paper, or not. Apart from the criticisms that he had offered, the paper contained much valuable and interesting information, and the author was to be congratulated.

Mr. MORDAY did not think such a machine as had been described would be found necessary; there were other means of arriving at the same ends. He asked whether the author was justified in using vectors as he had done; as soon as distortion entered the problem vectors should not be used; under such conditions the results arrived at from the study of vectors could not be relied upon at all.

Major A. M. TAYLOR called attention to a paper recently read by Mr. F. J. Moffett before the Staffordshire Iron and Steel Institute, in which the author very impartially considered several types of furnace, and his remarks upon the importance of sealing up the furnace to render it airtight; the heat lost through the electrodes and the water-cooled glands seemed to him (Major Taylor) to bear quite materially upon the question of single-phase *versus* three-phase furnaces. Referring to the tests of the balancer devised by Prof. Walker, he said it would appear that the power factor of the secondary circuit, external to the machine, was as high as 0.96. From that it was deduced that there was no external reactance, and that the whole of the reactance giving the curve shown in fig. 6 was contained in the secondary winding of the machine. He wondered whether the above large reactance was inseparable from the characteristics of the machine as, in certain circumstances, that might prove to be a disadvantage. He noted that the power factor of the primary circuit was about 0.91 at full load; the large secondary inductance was not, therefore, entirely neutralised. That was disappointing if it represented the limit to which the power factor improvement could be carried. It was worth noting that Mr. Moffett, in his paper, gave 0.85 to 0.95 as the power factor obtaining with arc furnaces, whereas Prof. Walker gave only 0.7 power factor. He hoped the meeting would bear with him in alluding to an invention of his own, and he would point out that, if an arc furnace could be got to work with 75 periods—and he understood that there were hundreds working in America at 60 periods—then his static frequency changer would be eminently suitable for working off systems which worked at 25 periods. The frequency changer had the following characteristics: No rotating parts; high efficiency—estimated at 95 per cent. for 500 KW.; unity power factor on the secondary side allowing enormous currents at low voltages to be supplied with a minimum amount of copper in the leads; giving a curve like fig. 6, so much commended by the author; perfect balance on all three phases, whatever the load. He believed that the poor power factor on the primary side could be rectified at a cost of about £1 per KW. by Kapp or other phase advancers. He had been working lately on a proposal which, if it fulfilled expectations, would enable a single-phase current of any periodicity whatever to be given from the secondary at unity power at a very low capital cost with high efficiency, with a perfect balance on the primary loads, with high power factor in the primary, and absolutely without any moving parts. Assuming that the inherent reactance of Prof. Walker's balancer could be kept low, it seemed to him that a very great field was opened for such a machine, quite apart from furnace work, and he wished it every success. He did not consider that the experiment quoted on page 18 proved that the balancer could deal with, say, a motor load of a poor power factor (such as 0.7) and yet give unity power factor in the primary, together with a balanced load. Perhaps Prof. Walker would reply to that point, and also say how the capital cost of the balancer compared with the cost of a single-phase generator at the generating station.

Mr. SAYERS doubted whether such a machine as described by the author would be found efficient in practice, his objections being based on the fact that the machine was a rotating one.

Mr. COATS disagreed with the author's claims that superior regulation could be obtained with single-phase furnaces. To-day three-phase furnaces were automatically controlled, both as regards dip and current; the statements made by the author in this respect were not at all correct. The additional expense of rotating machinery would be a further disadvantage of the author's scheme.

Mr. GIFFORD stated that all the original Hercult furnaces were of the single-phase type, and the original furnace was still in active service in France. A departure from single-phase had been made in this country on account of the cost of motor converters. In his opinion, all furnaces up to 5 tons capacity should be single-phase, and those above, three-phase; the power factor also had an important bearing on the problem. A great disadvantage of rotating machinery was its high cost. The risk of breakdown should not be forgotten; spare parts were difficult to obtain at short notice, such parts were not usually carried on hand, and they introduced higher costs.

Mr. MERCER said that when he joined the Ministry of Munitions in connection with electric furnace work he made the discovery that the best results were claimed for every type of furnace; each maker claimed that his own particular make was the best. There were many good furnaces in this country doing good work; he gave instances where 70 tons had been produced by one furnace with a consumption of 220 units per ton, and another case of 180 tons per month with a consumption of 1,035 units per ton. On the face of it these results seemed good, but accurate and fair comparisons could only be arrived at after careful consideration. One had to consider what the furnace was actually doing, whether it was merely melting metal, or melting and refining. He said that the smallest furnace in this country had a capacity of ¼ ton; he had personally inspected practically every electric furnace at work in this country, and he thought on the whole the 3-ton furnace gave the best results. A great deal of trouble had been experienced with the bottom electrode and the water connection; much astonishment would be expressed were the actual number of breakdowns known that had been caused through the failure of water connections. With regard to electrode consumption, he saw no reason why all furnaces should not have a good record to show in that respect.

The AUTHOR, in reply, said that it had been assumed that the single-phase furnace could only have one electrode at the top. That was not the case, and there was no reason at all why such furnaces should not have any number of top electrodes in parallel. By such an arrangement all the electrodes would be at the same voltage, and there would, therefore, be no fear of short circuits between them. A single-phase furnace was primarily intended for melting purposes and not for refining. One had to know precisely under what conditions the furnace was to work and what it actually had to do before its advantages and disadvantages could be properly discussed.

NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

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19,340. TIME-LAG DEVICES FOR ELECTRIC AUTOMATIC SWITCHES. F. C. Fake and New Switchgear Construction Co. November 25th.

19,372. METHOD OF MAGNIFYING TELEGRAPH SIGNALS BY MEANS OF THREE ELECTRODE VACUUM DEVICES. N. P. Hinton & E. H. Shaughnessy. November 25th.

19,374. ELECTRIC LAMPS. E. F. Heath. November 25th.

19,388. ACCUMULATOR PLATES. C. P. Elieson. November 25th.

19,399. ELECTRIC INCANDESCENT LAMPS. H. Ozaki. November 25th.

19,404. ELECTRICAL CONTACT MAKERS. J. L. Scott. November 25th.

19,422. OPERATING AND TRIPPING MECHANISM OF OIL-BREAK ELECTRICAL SWITCHES. R. T. Norton. November 26th.

19,460. FILAMENTS OF HIGHLY-REFRACTORY METAL. Westinghouse Lamp Co. November 26th. (U.S.A., December 19th, 1917.)

19,465. MEANS FOR GENERATING HIGH-FREQUENCY ELECTRIC CURRENTS. I. Shoenberg. November 26th.

19,468. MEANS FOR SUPPORTING SHADE OF ELECTRIC INCANDESCENT LAMP. L. G. Flory. November 26th.

19,491. SOUND TRANSMITTING INSTRUMENTS. A. Marr. November 26th.

19,492. TELEPHONIC HEAD-PIECE RECEIVERS. A. Marr. November 26th.

19,494. PROTECTIVE DEVICES FOR ALTERNATING-CURRENT SYSTEMS. A. E. McColl. November 27th.

19,569. ELECTRIC COUPLINGS. C. W. Saunders. November 27th.

19,595. FILAMENTS. Westinghouse Lamp Co. November 27th. (U.S.A., December 19th, 1917.)

19,630. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. C. K. Shepherd. November 28th.

19,649. MEANS FOR CONTROLLING SPEED OF AIR-DRIVEN DYNAMOS. G. H. Trotter. November 28th.

19,650. MEANS FOR REGULATING SPEED OF AIR-DRIVEN DYNAMOS. G. H. Trotter. November 28th.

19,664. ELECTROPLATING INTERNAL-COMBUSTION ENGINE CYLINDERS, &c. Q. Marino & A. Ness. November 28th.

19,675. CURRENT REGULATORS FOR ALTERNATING-CURRENT ELECTRIC CIRCUITS. W. Langdon-Davies & A. Soames. November 28th.

19,728. ELECTRICAL TRANSMISSION OF SYNCHRONOUS MOVEMENTS. R. Van Couwenberghe. November 29th. (France, February 24th, 1916.)

19,756. ELECTRODES OF ELECTRIC FURNACES. Soc. Electro-Metallurgique Francaise. November 29th. (France, December 3rd, 1917.)

19,759. PROTECTIVE DEVICES FOR ALTERNATING ELECTRIC CURRENT DISTRIBUTION SYSTEMS. British Thomson-Houston Co. & E. B. Wedmore. November 29th.

19,777. AUTOMATIC QUICK-SILVER SWITCHES FOR ELECTRIC FLAT IRONS. Avanti Dansk Elektro-Mekanisk Fabrik & N. F. Nielson. November 29th.

19,785. APPARATUS FOR TRANSFORMING ELECTRICAL ENERGY. J. E. Calverley and W. E. Highfield. November 29th.

19,792. SHOCK-ABSORBER AND PROTECTOR FOR ELECTRIC LAMPS. J. W. Graham. November 30th.

19,814. VISUAL AND AUDIBLE ELECTRIC INDICATORS. J. G. Rose. November 30th.

19,818. METHOD OF ELECTRICALLY WELDING IRON, STEEL, BRASS, &c., STUDS TO IRON, STEEL, &c. A. E. Franking. November 30th.

19,831. STARTING RESISTANCES FOR ELECTRIC MOTORS. T. A. D. Lawton. November 30th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

14,197. "Electrical starting apparatus for internal-combustion engines." BIJUR MOTOR LIGHTING CO. November 24th, 1915. (110,356.)

14,582. "Thermo regulators and alarms." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) October 9th, 1917. (120,412.)

16,103. "Insulator and binder for telegraph, telephone, electric, and other wires." A. SPENCER. November 5th, 1917. (120,418.)

16,122. "Constitution of the magnetic circuit in electric ignition apparatus for internal-combustion engines." AKT. GES. BROWN, BOVERI ET CIE. January 12th, 1917. (112,926.)

16,202. "Electric switches." A. HOLT. November 6th, 1917. (120,423.)

16,223. "Electric heating and cooking apparatus." W. H. BENNETT. November 7th, 1917. (120,426.)

16,266. "Magneto-electric machines." BRITISH THOMSON-HOUSTON CO., A. P. YOUNG & A. G. SALISBURY. November 7th, 1917. (120,431.)